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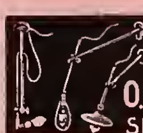

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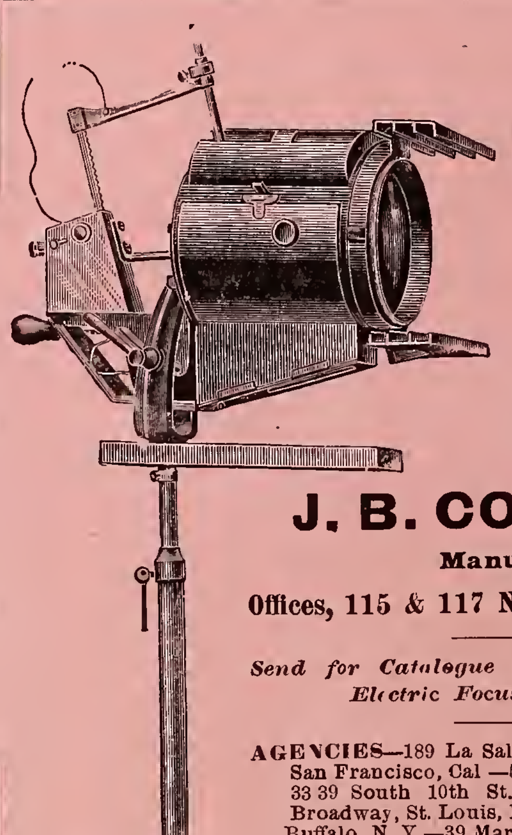

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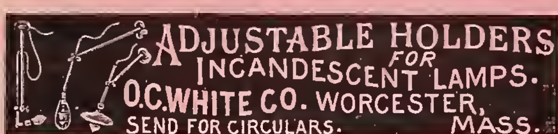

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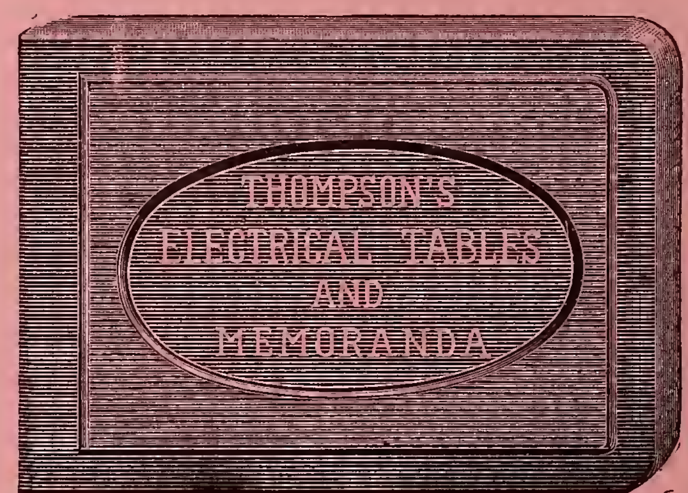

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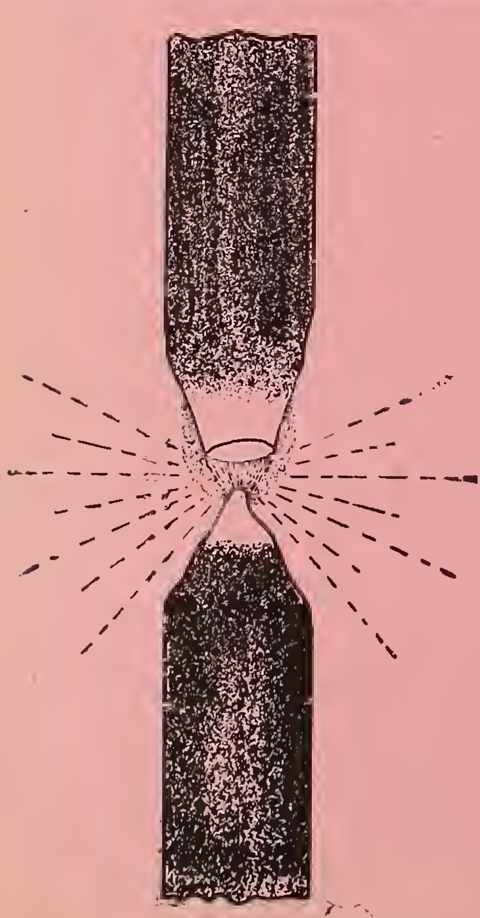

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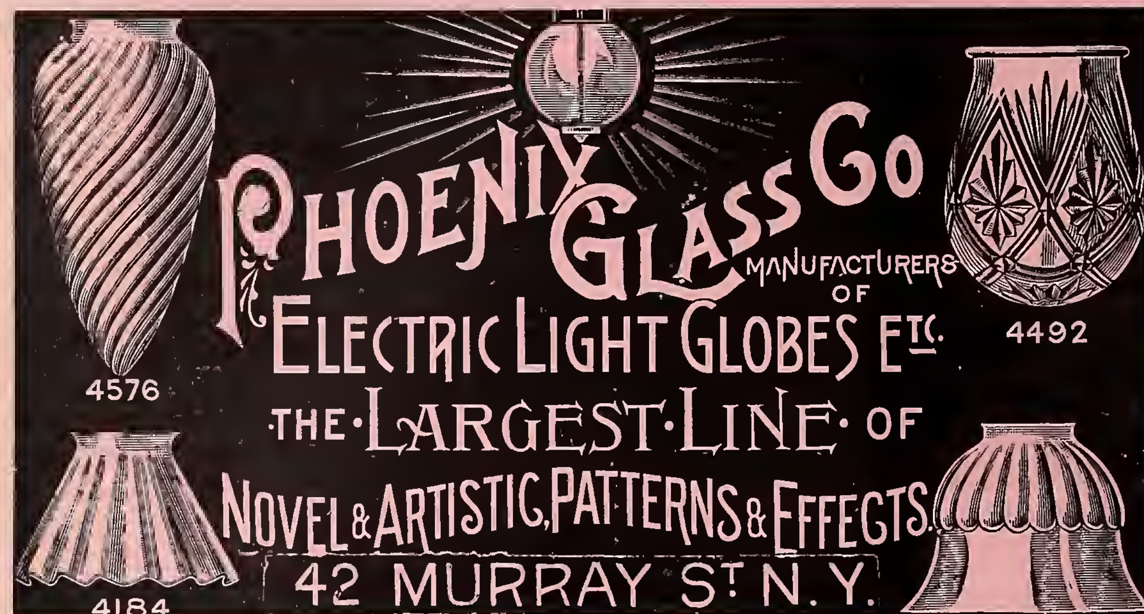

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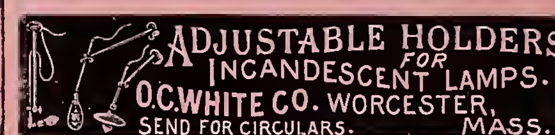

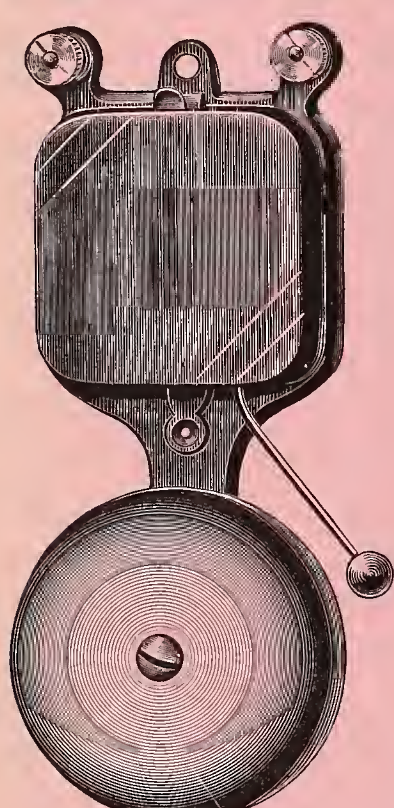

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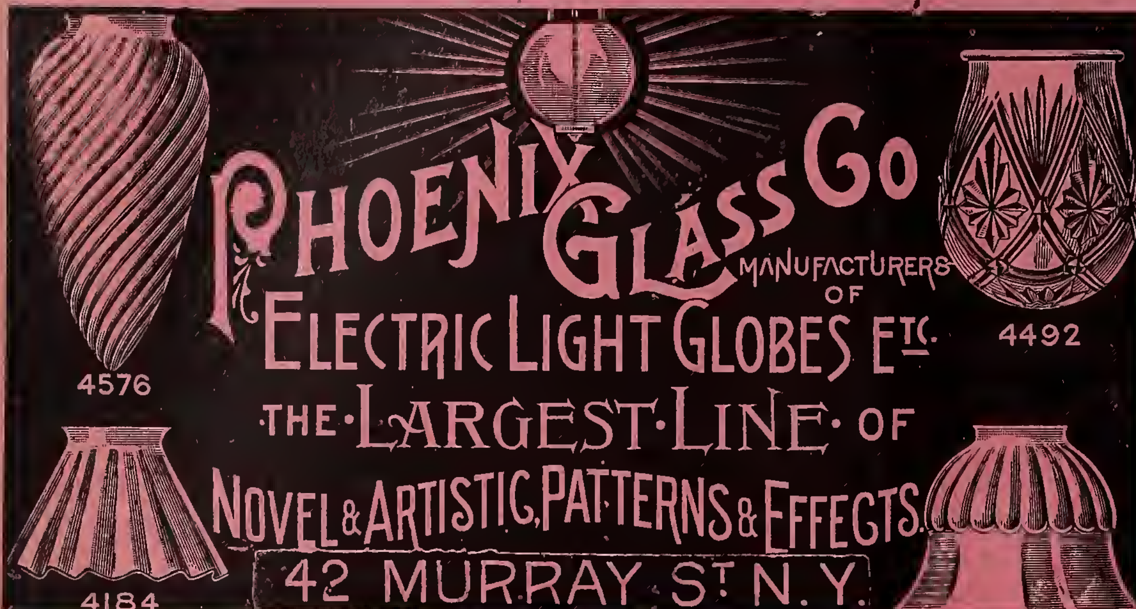

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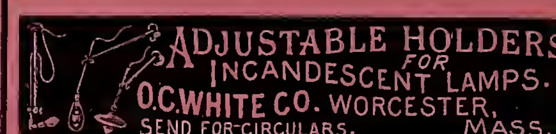

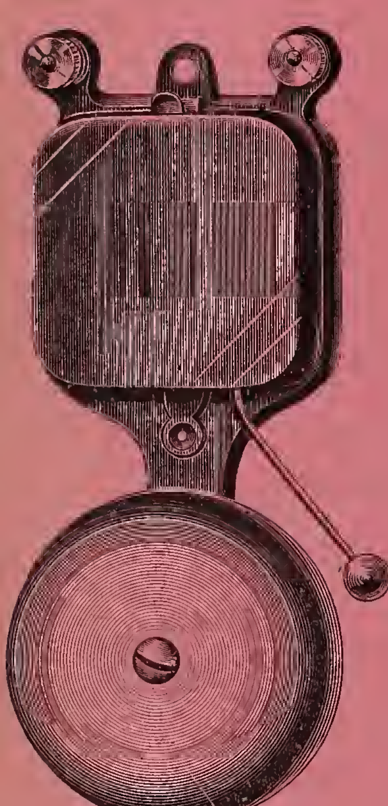

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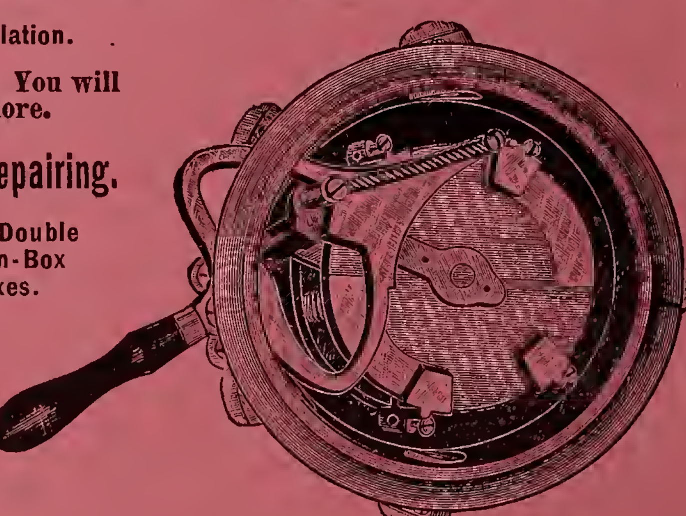

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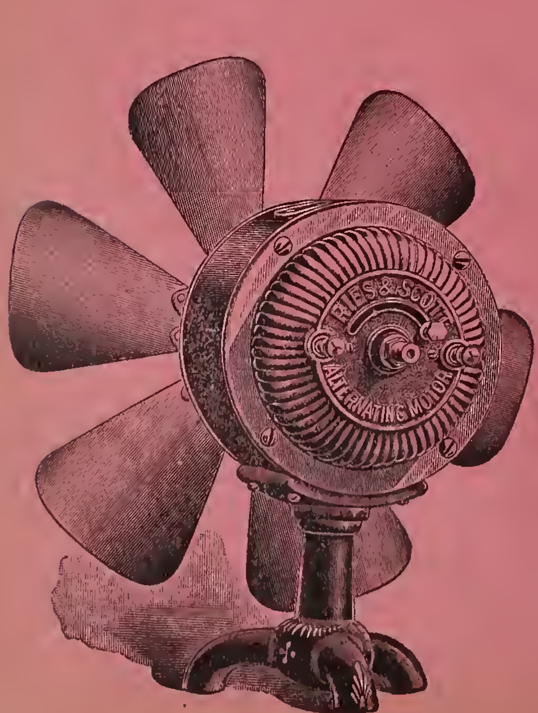

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CONTENTS.

THE GOVERNMENT TELEPHONE SUIT.

Judge Colt in the United States Circuit Court, Boston, on December 30, gave the United States until May 31, 1896, in which to take evidence in rebuttal in the case of the United States agt. the American Bell Telephone Company and Alexander Graham Bell, in which the question of fraud in procuring the Bell Company's patent is raised. Judge Colt refused to limit the Government to the question of fraud raised. The Government has taken a vast amount of evidence in support of the claim of Daniel Drawbaugh, and the defendants have taken countervailing evidence on the same issues. The Government now wishes to take evidence to rebut the defendants' evidence, and the Court has given time for that purpose without restricting the Government from taking evidence on the question of alleged priority of invention, which it would have done had it granted the request of the defendants.

WHAT A LONDON FOG COSTS.

A November fog in London costs, it is said, in gas, electric light, accidents, delays and damage $500,000.

REWARDING CAREFUL SERVICE.

The Steinway Electric Company, Long Island City, N.Y., on December 23, distributed between $4,000 and $5,000 as Christmas gifts between 192 of its employés. Prizes of $25 where paid each motorman and each conductor who worked through the year without an accident. Ninety-eight men got $25 prizes.

AN EFFECTIVE METHOD OF PREVENTING ACCIDENTS ON ELECTRIC ROADS.

It is stated that the police authorities of Genoa have prohibited the further operation of electric cars on account of recent numerous accidents. In descending gradients the brake-power of the cars either failed or was not promptly applied, resulting in the derailing of the cars and causing trouble generally.

ELECTRICALLY WELDED RAILS.

Mr. Robert McCulloch recently read an interesting paper before the Engineers' Club, of St. Louis, on the subject of welding rails by electricity. He states that of 2,203 electrically-welded joints on three and one-quarter miles of double-track in St. Louis, 72 joints or 3.27 per cent. have broken. Thirty-seven broke during the cold weather of the first part of last winter, and each was repaired by casting a mass of iron around the broken part, a portable furnace being employed to melt the iron. During the second cold snap later in the same winter 35 more breaks occurred, which have not yet been repaired. Seven of the joints opened nearly two inches on breaking, while in the others the crack was barely perceptible; the average amount of opening was about a quarter of an inch. During the warm weather of the past summer these cracks closed a trifle, but the amount of the movement was unimportant. The maximum deviation from the average temperature at which the welding was performed has been about 75 degrees. Every joint that has broken has shown traces of imperfect welding; in all cases the rail ends have simply pulled apart, the lugs remaining fast to the rail which held them the tighter. This experience is contrary to that in Boston, where the rails themselves broke near the weld. The machines used in making the welds in St Louis were sent from here to Cleveland, where 3,400 joints were made in the summer of 1894. Six of these joints, or 0.18 per cent. broke during the last winter, each failure being due to imperfect welding. The method of making continuous rails by casting a mass of iron around the joints has been tried in St. Louis, Chicago, St. Paul, Minneapolis and Newark. About 27,000 of these joints have been cast in the cities mentioned, and the results are reported to be satisfactory to both the railway companies and the contractors.

WHAT HAPPENED IN 1895.

In looking over the record of events during the past year the first thing we find is an account of the reception given by Messrs. Godfrey, Harrington and Olsen to the electrical fraternity in their new offices, No. 15 Cortlandt street. This famous trio had just combined their forces in favor of the India-Rubber and Gutta-Percha Insulating Co., manufacturers of the well known "Habirshaw" wires, and celebrated the New Year by keeping open house. The finger of time has passed around one year more towards eternity and we find the same three repeating the ceremony of one year ago. Red, white and blue forever; long may they wave.

On January 14 the great strike between the Brooklyn City Railroad Company and its employés occurred. This was one of the bitterest struggles on record, but the men were finally compelled to yield. There was great disorder and much damage was done, and the state militia was called out to preserve order.

The Franklin Electrical Society, New York City, on January 19, celebrated the 189th anniversary of the birth of Benjamin Franklin, by giving a dinner.

Rudolph Eickemeyer, the well-known electrical engineer and inventor, died in Washington on January 23.

The 18th meeting of the National Electric Light Association was held in Cleveland, Ohio, on February 19, 20 and 21. There was a large attendance and the convention was a great success in every particular. Valuable papers were read by eminent authorities. Mr. C. H. Wilmerding, of Chicago, was elected president for the years 1895–96.

WM. J. RICHARDSON, DIED APRIL 26, 1896.

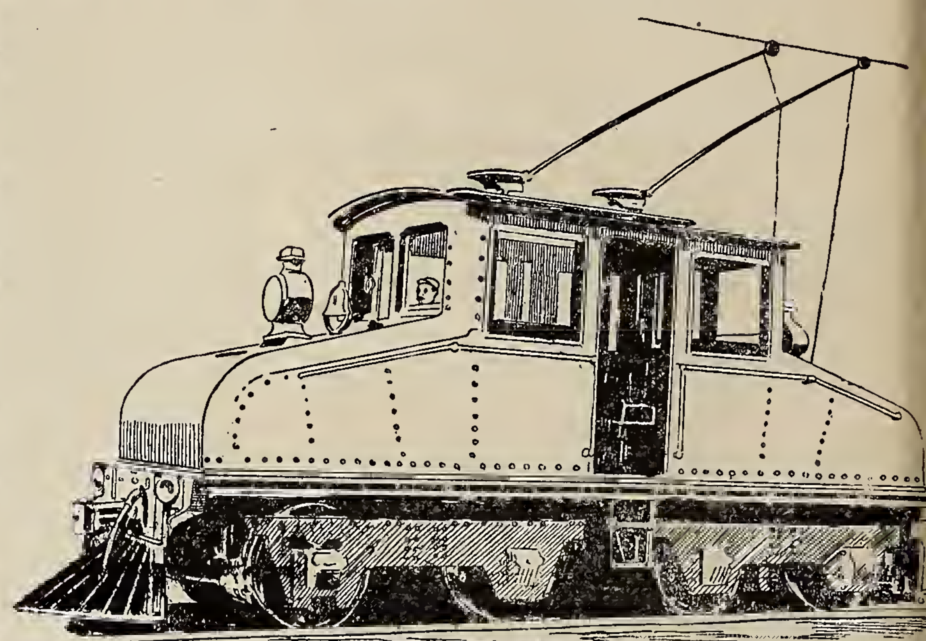
The celebrated Bate Refrigerator case was decided by the United States Supreme Court on March 4. The effect of the decision was to render null and void several important electrical patents.

The building in which was located Mr. Nikola Tesla's laboratory was destroyed by fire on March 13. All of Mr. Tesla's apparatus was destroyed.

On March 22 the Citizens' Electric Illuminating Co., of Brooklyn, gave an exhibition of the Stanley-Kelly-Chesney two-phase alternating system introduced into the station experimentally. A large number of people were present.

The Edison Electric Illuminating Company, of Brooklyn, gave their annual reception at the Pearl street station on the night of April 3.

The factory of the Crocker-Wheeler Electric Co., at Ampere, N. J., was destroyed by fire on Sunday, April 7.



WESTINGHOUSE-BALDWIN ELECTRIC LOCOMOTIVE.

Mr. G. M. Phelps, president of the *Electrical Engineer* Company, died of pnemonia on April 11.

W. J. Richardson, of Brooklyn, secretary of the American Street-Railway Association, died on April 26, of spinal meningitis.

The Metropolitan Elevated Railroad, Chicago, was formally opened on April 17. This road is operated by electric power.

The Baltimore Tunnel was opened for business on May 1.

ELECTRICAL CARNIVAL, SACRAMENTO, CAL., SEPT. 9, 1895.

On May 18 the United States Circuit Court of Appeals rendered its decision in the case of the American Bell Telephone Company *et al.*, appellants, vs. the United States of America, appellees. The decision of the Circuit Court was reversed, and was in favor of the Bell monopoly. Judge Carpenter, in the lower court on December 18, 1894, decided that the Berliner patent was invalid, but this decision was reversed by the Court of Appeals, as above indicated.

On May 23 the painting, "The Projectors of the Atlantic Cable," was presented to the Chamber of Commerce, New York, amid great enthusiasm. A large gathering was present to witness the interesting ceremony.

The annual convention of the Association of Railway-Telegraph Superintendents was held in Montreal on June 12 and 13.

On June 21 the electric system on the Nantasket Beach branch of the New York, New Haven & Hartford Railroad was successfully tested.

F. L. POPE, DIED OCTOBER 13, 1895.

The Hon. Jos. B. Stearns, well-known in the electrical field as the inventor of a duplex system of telegraphy, died on July 4 at his home in Camden, Me.

The 15th reunion of the United States Military Telegraph Corps and Old-Time Telegraphers and Historical Association was held in New York on September 11, 12 and 13.

The 12th general meeting of the American Institute of Electrical Engineers was held at Niagara Falls, N. Y., on June 25, 26, 27 and 28.

The Northwestern Electrical Association held its sixth convention at Chicago on July 17, 18 and 19.

The Burlington and Mt. Holly branch of the Pennsylvania Railroad was on July 22 operated for the first time by electric power.

On August 5 a deal was effected between the Westinghouse Electric and Manufacturing Co., of Pittsburgh, and the Baldwin Locomotive Works, Philadelphia, by which the latter concern will build electric locomotives for the Westinghouse Company.

On August 6 the American Bell Telephone Co., Boston, served papers on the National Telephone Mfg. Co., of the same city, in a suit for an order restraining the latter company from infringing the Berliner patent.

The first electric railroad in Berlin, Germany, was opened during the month of August.

The convention of the Association of Edison Illuminating Companies was held at the Hotel Cadillac, Detroit, on August 13, 14 and 15. The next meeting will be held in Brooklyn, or its vicinity, on the second Tuesday in August, 1896.

The annual destruction of clams and other edible and liquid products of Rhode Island, Milwaukee and France, under the auspices of the American Electrical Works, Providence, R. I., took place on the shores of Narragansett Bay, on August 17. There has been a great scarcity of clams ever since.

A grand electrical carnival was held in Sacramento, Cal., on September 9, to commemorate the opening of the long-distance power plant by the Folsom Water-Power Company.

The Atlanta Exposition was formally opened on September 18. President Cleveland touched a button at Gray Gables, and something or somebody else did the rest.

The Street Railway Association of the State of New York held its annual meeting at the Kenmore, Albany, N. Y., on September 17.

The Canadian Electrical Association held its fifth annual convention at Ottawa on September 17, 18 and 19.

ELECTRICAL BUILDING, ATLANTA EXPOSITION, OPENED SEPT. 18, 1895.

H. M. LITTELL, PRESIDENT A. S. R. A., ELECTED OCTOBER 17, 1895.

The General Telephone Protective Association was organized in New York City on August 21. The purpose of this association is to protect the interests of its members and their customers against suits of infringement of the Berliner patent, No. 463,569, which patent the Bell Telephone Company is trying to use as a whip to bring all independent telephone interests under subjection.

During the early part of September the United States District Attorney at Chicago was requested in behalf of the people to bring a suit against the Bell Telephone Company for violation of the anti-trust laws. A similar request was made to Attorney General Moloney, of Illinois, to prosecute the same company for violation of similar state laws.

Mr. Franklin L. Pope, the well known electrical engineer, was killed by electric shock at his home in Great Barrington, Mass., on October 13.

The 14th annual convention of the American Street-Railway Association was held in Montreal on October 15, 16 17 and 18. There was a large attendance and a large exhibition of railway supplies and apparatus. Mr. H. M. Littell, of Brooklyn, was elected president of the Association for the ensuing year, and Mr. T. C. Penington, of Chicago, secretary and treasurer. The next convention will be held in St Louis.

On October 19 the works of the Carborundum Company at Niagara Falls were put into operation, the current being obtained from the Cataract Company power-house.

On November 11 the United States Supreme Court decided that it has jurisdiction over the case of the United States vs. the Bell Telephone Company to cancel the Berliner patent, which the Court of Appeals for the first district decided against the government. The telephone company had moved to dismiss the appeal on the ground that the United States Supreme Court had no jurisdiction.

The Supreme Court of the United States on November 11 rendered an opinion sustaining the Edison incandescent light patent against the claim of the Consolidated Electric Light Company, using the Sawyer Mann system, of which it was claimed the Edison system was an infringement.

The explosion of a steam-pipe in the engine-room of the Elizabeth Street Station of the Brush Electric Light Co., New York, on November 15, did considerable damage to the electrical plant.

The employés of the Union Traction Company, Philadelphia, went on strike on December 17. The strike lasted until December 23 and caused a severe financial loss to Philadelphia tradesmen, coming as it did first at the Christmas season. There was some rioting and damage to the company's property.

CONSOLIDATION OF PITTSBURGH ELECTRIC ROADS.

The Pittsburgh Traction Company, the Duquesne Traction Company and the Central Traction Company are now practically part of the Consolidated Traction Company. The stockholders of the three corporations voted on Dec. 23 to lease their properties to the Consolidated Company for a period of 950 years. The consolidation aggregates an annual rental of $340,000.

HABIRSHAW WIRE RECEPTION.

On the afternoon of December 31 Messrs. Godfrey, Harrington & Olsen gave a reception to the electrical fraternity at their offices, No. 15 Cortlandt street, New York. There was a very large attendance, and the presence of Mr. W. M. Habirshaw on this occasion added considerable interest to the event.

Messrs. Habirshaw, Godfrey, Harrington & Olsen received the good wishes from their many friends with affable grace, and a general good time was had. The meeting brought together many who rarely see each other during the year, and the rekindling of friendships was an interesting feature of the occasion.

RECEPTION OF MESSRS. GODFREY, HARRINGTON & OLSEN, DECEMBER 31, 1895.

In the limited space at our command it is impossible to give a list of the names of those who called to pay their respects to the invincible quartette. All expressed the heartiest good wishes for the success of Habirshaw wires during the year.

On November 25 a sleet storm in and around Chicago did great damage to telegraph and other electrical wires.

The National Electrical Exposition Company, of New York, was organized early in December, for the purpose of holding a great exhibition of electrical apparatus and supplies during the month of May, 1896, and in connection with the convention of the National Electric Light Association.

On December 9 Judge Townsend, of the U. S. Circuit Court, District of Connecticut, rendered a decision upholding the validity of the fundamental Van Depoele underrunning trolley contact patent, but declaring void the Van Depoele patents covering a rotating support for the post upon which the contact arm swings.

The Phœnix Iron Works, Meadville, Pa., have on hand one of their improved four-cylinder triple expansion condensing 500 H. P engines, ready for immediate shipment. Any one in need of an engine of this type will do well to communicate with the Phœnix Iron Works at once. See advertisement on page v.

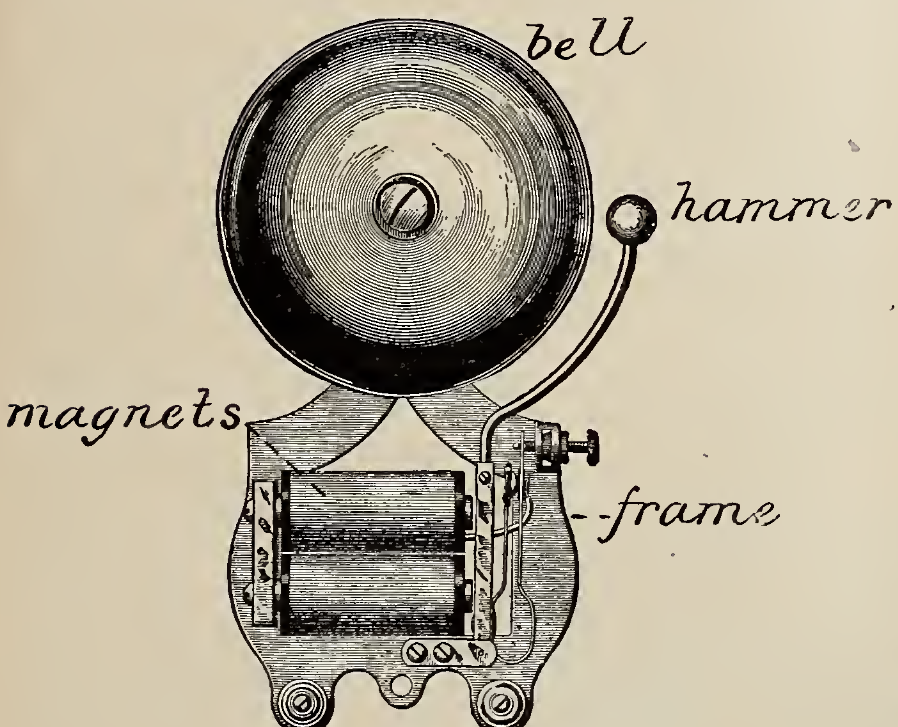
DEPARTMENT OF ELEMENTARY EDUCATION.

BY THE EDITOR.

[*Note.—Any one is invited to ask questions on any point that is not made clear in these articles. Suitable explanations will be cheerfully given under the head of "Answers to Inquiries."*]

ELECTRIC BELL CIRCUITS.

In the following papers an endeavor will be made to give plain, general instructions for the wiring of houses and other buildings for electric bells, burglar alarms, annunciators, gas-lighting, etc. In addition to these instructions it is our purpose to describe the different pieces of

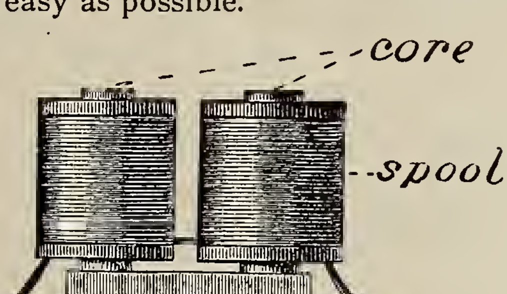


ELECTRIC BELL.

apparatus used in such work, and give other incidental information that will assist the practical workman in attaining the best results in the easiest possible manner.

Wherever it is possible, illustrations and diagrams will be used—and as liberally as possible. A clear, well-designed illustration of a piece of apparatus tells its story to the mind quicker than a lengthy description in words of the same thing, besides saving time and mental fatigue.

We will also give diagrams of a great variety of electric bell circuits. A simple circuit will not answer every purpose. It is frequently necessary to instal an electric bell system of a more intricate character; many connections are required in such cases and the results to be accomplished vary greatly. We hope, however, with the aid of special illustrations of such circuits to render the labor of the workman as easy as possible.



ELECTRO-MAGNET.

In the first place we need tools. What tools are necessary? A brace and several size bits, one 12-inch and one 24-inch twist point bell-hanger, files, screw drivers, chisels, hammers, etc., constitute a good outfit for ordinary work. There is really no special tool necessary for electric bell work; what tools are used comprise a part of every carpenter's outfit.

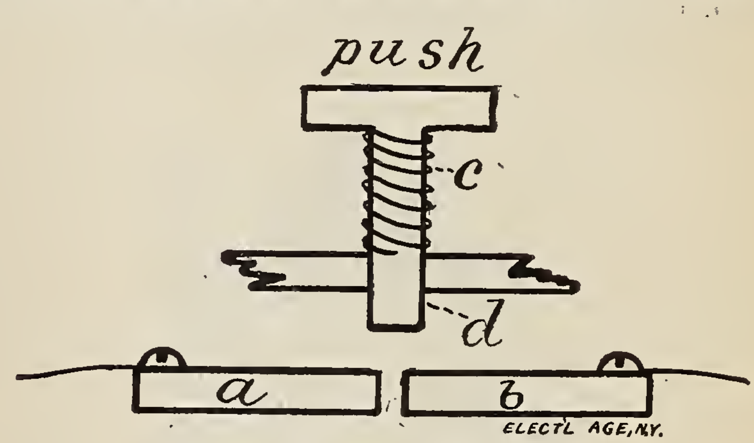
The electrical supplies for a simple electric bell circuit consist of a bell, battery, push-button, wire and staples.

Before describing such a circuit let us first give a little attention to the construction of the bell, the push-button and the battery, in order that we may better understand the operation of the circuit as a whole.

The electric bell (our English friends call it a "trembling" bell) in the ordinary form is shown in the accompanying illustration. The main parts are the frame (generally of iron), the electro-magnets, the bell or gong and the hammer.

For the benefit of those who are not familiar with the construction and action of the electromagnet, we will briefly explain the same.

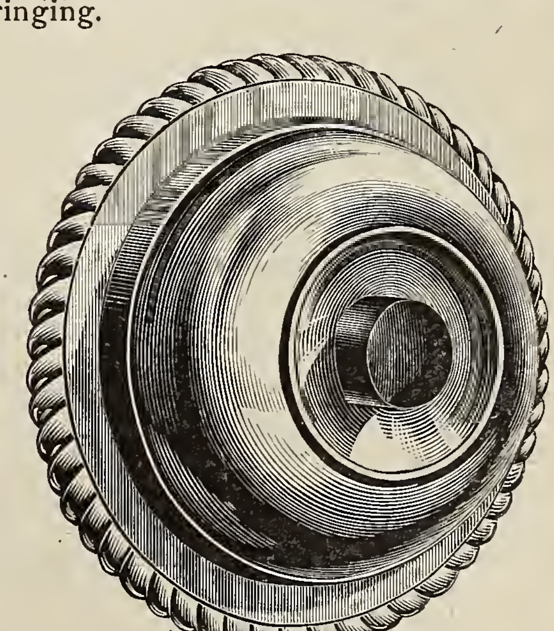
An electromagnet (see diagram) consists of two short lengths of soft iron rod, over which are slipped two spools of insulated wire. The two lengths of iron are joined together at one end by a cross piece of iron, so that the core complete has the general shape of the letter U, but with square corners. The ends of the wires of the two spools are joined together, so that when an electric current is



PRINCIPLE OF THE PUSH BUTTON.

present it enters one spool and passes out the other. An electric current in thus passing around the wire on the spools exerts a peculiar effect upon the iron cores—the cores becoming magnetic and will attract towards themselves pieces of iron or steel. As soon as the electric current is interrupted the magnetic attraction ceases. This intermittent magnetic attraction is the vital principle of the electric bell, and its action in the practical bell will be explained more fully later on.

The push-button is a device to close the electric circuit in order to ring the bell. Electric-bell circuits are what are called "open circuits;" that is, no current flows from the battery when the bell is not in use. Push-buttons are placed at some convenient point, and on pushing the button with the finger the circuit is "closed"—which allows the current to flow from the battery and ring the bell. The moment the pressure is released from the button the circuit is again broken; the current ceases to flow and the bell stops ringing.

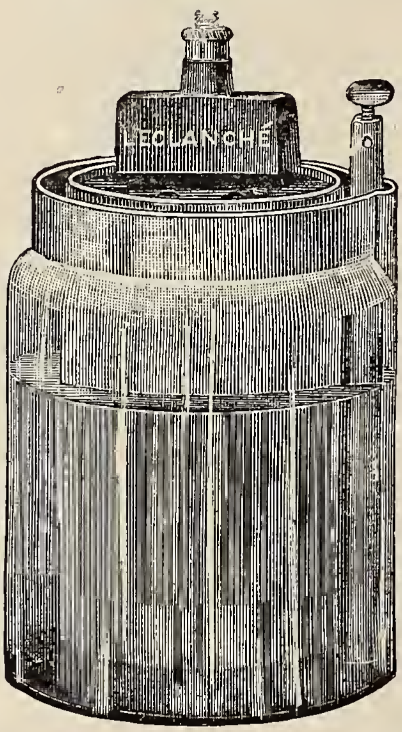


PUSH BUTTON.

The principle involved in the construction of a push-button is very simple, as will be seen by the accompanying diagram. The practical effect of the push is exactly the same as if we took a wire, cut it in two and then touched the ends together. We would then close the circuit, just as the push-button does; the push-button, however, offers a much more convenient way of accomplishing the same result.

Push-buttons are made in a great variety of designs and of different materials. The ordinary push is made of wood (see illustration). For handsome offices, front doors and in other places where the surroundings are above the ordinary, metal and bronze push-buttons may be had. Illustrations of a few selected varieties are shown herewith. Push-buttons of all designs can be obtained at any supply house.

Battery.—We now come to the battery, which is in reality the heart of the system. It is from the battery that the current flows. The battery is very much like the human heart, and the electric current may be compared with our blood. If the heart is weak the current of blood through our veins is correspondingly weak; but if it is strong and healthy, our bodies are vigorous and we respond quickly to the life-giving principles of the strong current of blood. This analogy is obvious.



LECLANCHE BATTERY.

For a simple and short bell circuit some people try to make one cell of battery do the work of ringing the bell. Sometimes the battery succeeds, but frequently it does not. In such cases the trouble is usually charged to everything but the real cause.

Two cells of battery should be used to get the best results. If the circuit is short two cells will make the bell rattle vigorously, but that is what the bell is for—to make a noise. The longer the circuit the more battery will, of course, be required—the increase of battery power depending upon the length of the wire. A good rule is to allow one cell of battery for, say, every 100 feet of wire, with the bell in circuit.

There is a great variety of "open-circuit" batteries on the market adapted for bell work. They are most all modifications of the Leclanche cell, however.

Bell batteries are so familiar that a detailed description of them is unnecessary. The carbon constitutes the positive element or pole, and the zinc the negative. The two elements are immersed in a solution of sal-ammoniac and then the battery is ready for operation.

Wire.—In bell work, No. 18 copper-insulated wire is generally used. No. 18 wire is practically 3/64ths of an inch in diameter, and has a resistance of nearly .640 ohms per 100 feet. There are about 130 feet of wire to the pound. The insulation consists of braided cotton paraffined. It is good for inside use, but not for outside. If 100 feet measures .64 (sixty-four one-hundredths) ohm resistance, ten feet would measure .064, or nearly six-and-a-half one-hundredths of an ohm; one thousand feet would measure 6 4 ohms (nearly 6½).

One hundred and fifty-six and forty-seven hundredths (156.47) feet of No. 18 copper wire measures an ohm; therefore 212.94 feet would have a resistance of two ohms, and 10 ohms would represent a length of 1564.7 feet.

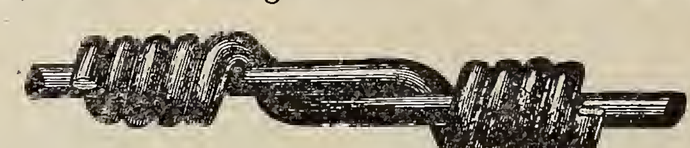
The figures and units of measurement just given are valuable to remember, for the reason that the longer the wire the greater the resistance, and consequently the greater battery power necessary to overcome the resistance.

Larger wire (say, No. 16), of course, could be used with advantage in large bell installations in order to reduce the number of cells of battery necessary for their operation, but as the wire is the most expensive item in bell work, No. 18 has been adopted as the happy medium between cost of installation and service rendered.

At this point it may be well to speak of a very important matter in connection with wiring, and that is, making joints between the ends of wires. A poor joint adds abnormal resistance to the circuit, and if the joints are poor enough (as they are liable to be when made by cheap or inexperienced workmen), the bell will preserve a dumb silence—all of the power of the battery will be consumed in overcoming the resistance of the bad joints, or trying to overcome it. Therefore, be careful of your joints.

The way to make a joint is this: Take the ends of the wire you wish to unite and strip the insulation back about two or three inches. Having done this, scrape the bare wire with a knife blade, or rub it with sand-paper or emery paper, in order to clean the metal of the paraffine and any other undesirable substance that may adhere to the surface. Then, when the surfaces are clean and bright, twist the two wire-ends around each other as firmly as possible, using pincers or pliers for the purpose. An illustration of a first-class joint is shown in one of the accompanying illustrations.

Having joined the ends of the wires as directed, the joints *should be* covered with an insulating tape, so as to insulate them. This is not always done in ordinary bell work, but by not doing it you simply have so many loopholes for the current to stray from the right path should the exposed joints accidentally come in contact with a gas-pipe or with other foreign material, especially if the latter is damp or wet. To make a good job all points should be covered with insulating tape. The question of expense, of course, is an influencing factor. We believe in the saying



A FIRST-CLASS WIRE JOINT.

that "What is worth doing is worth doing well," and it applies as well to bell work as to anything else.

In new buildings the best time to run electric bell wires is when the partition studdings are placed in position, but before the lath is put on. Having decided upon the locations of the push-buttons, bells and battery, the connecting wires can easily be run from place to place, Their permanent position, of course, will be between floor-joists and partition studding, and when the lath is put on and the building is plastered only the ends of the wires will be visible—at the points where connections are to be made with push-buttons, bells and battery. Where the wires run horizontally, they should be tacked to the beams with double-pointed tacks (staples), in order to keep them straight. It saves wire to run it as straight as possible. When the wires drop from one floor to another, or from any high level to a lower one, ordinarily they may hang between the studding, but it is best to secure them also with tacks.

It is not advisable to use the same tack to hold more than one wire. Sometimes two wires are tacked down with one tack, but the objection to this is that "crosses" between the two wires may thus be caused. This is brought about by the tack breaking through the wire insulation sufficiently to form a metallic connection between the two bare wires. When such crosses occur they give endless trouble in locating them, and frequently make considerable rewiring necessary. Therefore, do the work well at the start; then it will not have to be gone over later on to find faults that could have been avoided in the first place.

(*To be Continued.*)

ANSWERS TO INQUIRIES.

[*Note.—This column is open to any of our readers who desire special information on any subject. In case we cannot give the desired information ourselves the inquiry will be published, in order to elicit a reply from some one of our readers. These answers will be published in due course.*

The full names of our correspondents will not be published, but for the purpose of identification their initials or other mark of identity will be substituted therefor.

Each question will be numbered for the purpose of ready reference.

All are invited to make free and liberal use of this column.]

THE TYPEWRITER IN THE TELEGRAPH SERVICE.

Old-time telegraph operators were proverbially excellent penmen, and they used to take great pride in their "copper-plate" copy. No doubt as much satisfaction was experienced by the recipient of a telegram written in beautiful characters, and probably the operator who did the flourishing was aware of the fact that his work was silently appreciated—we say "silently appreciated," because as far as the public is concerned the individuality of the operator, however expert he may have been, was not revealed. His work is all that the public sees.

Operators also used to pride themselves, and they do yet for that matter, in their ability as senders to "rush" the fellow at the other end of the wire, who, if he is not a gilt-edged artist, cannot take the time to put any frills on his copy. The rapid influx of dots and dashes compels him to adopt the shortest possible method of putting the message on paper. If he is an expert receiver, the person to whom the message is addressed will in all probability be able to read the contents of the missive, but in many cases the receiving operators, who may be young and striving to attain fame as expert receivers, rather than "break" the sender in his rapid flight, make discreditable work of their chirography. The frequent result of this condition of things is that the recipients of the messages experienced considerable difficulty in deciphering the hieroglyphics.

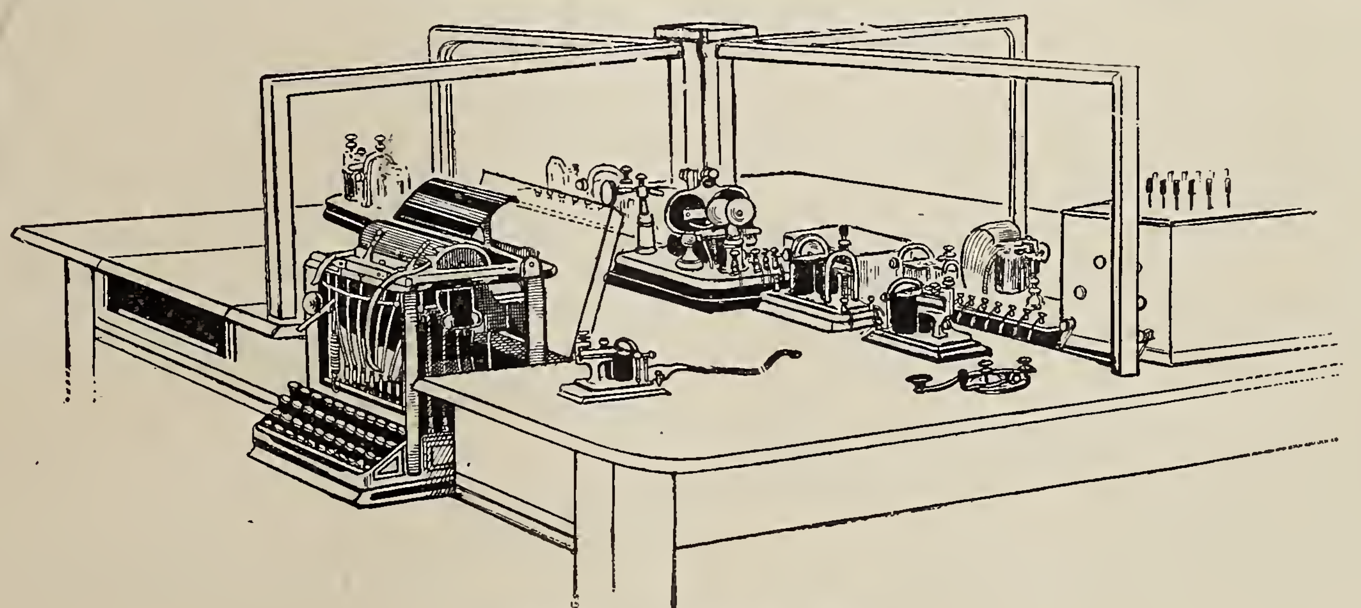
All this is now greatly changed, however, and the public to a very large extent receive their telegrams printed in plain legible characters by typewriter.

In most all large telegraph offices the typewriter is used altogether in copying messages directly from the wire, and as an ordinarily expert typewriter operator can tap the keys much quicker than the fastest sender can form the corresponding letters in dots and dashes, the receiver obviously has the advantage, and can take it easy, whereas in the days of yore to do the same work with the pen tended to shorten his days on earth.

The Postal Telegraph Company in its large offices makes provision for typewriter space on its telegraph instrument desks, and encourages its operators to use the machine. This company, known for its progressive spirit, took the lead in introducing typewriters in the general telegraph service, and made a success of the enterprise at the start. This, however, was not the first use of typewriters in telegraph work. In 1883 the Associated Press introduced machines on its wires between New York and Washington. This was the first use of typewriters on a large scale, and so successful was the experiment that machines were afterwards introduced in all offices of the Press Associations throughout the country. In the large press offices, as many as 20 and 30 manifold copies are produced on one machine at one writing. In order to make so many copies at once, a metal roller is substituted for the ordinary rubber platen on the typewriter.

The editor of THE ELECTRICAL AGE was the first one to take up the subject on an extensive scale, and it was under his personal supervision that the typewriter was introduced on the Associated Press wires. In order to meet with all the requirements of the service several special improvements were necessary in the machine, among which was the adoption of the metal roller, above referred to.

On all press wires a system of abbreviations is used by the operators in transmitting news dispatches over the wires. The sender abbreviates words and common phrases according to the code, and the receiving operator spells them out in full on the typewriter. He is enabled to do this on account of the higher speed possible on the typewriter as compared with the pen. This system of abbreviations increases the capacity of a wire from 25 to 40 or 50 per cent., according to the ability of the operators. The code of abbreviations in general use was invented by Walter P. Phillips, the general manager of The United Press, and is known all over the world as the "Phillips code."



TYPEWRITER ON TELEGRAPH DESK.

The accompanying illustration gives an excellent view of a typewriter on a telegraph desk. In some offices, provision is made to drop the typewriter entirely below the level of the top of the table when the operator wishes to "send."

PRINCIPLES OF DYNAMO DESIGN.

BY

Newton Harrison E.E.

(*Continued from page 336.*)

Heating of Armatures.—It is well known by even the casual observer that the limits of load are determined by the arrangement of the material used. The whole science of engineering demands the most economical adjustment, the proportioning of stresses and strains, of cross-sections and lengths, so as to provide for the greatest emergencies and yet utilize within certain limits the least quantity of material. In the development of an armature the successive steps call into action such methods; they illuminate the mind regarding the best cross-section of core, number of inductors, density of field, etc., and finally bring the builder to the point of almost final consideration, the provision of sufficient surface for radiation. The older and simpler practice required the use of a given number of circular mils. per ampere in the armature conductor.

Amperes.	At 400 circular mils. per amp.		At 450 circular mils. per amp.	
5	No. 17 B. & S.	2,000	No. 16 B. & S.	2,250
10	14 "	4,000	13 "	4,500
20	11 "	8,000	10 "	9,000
50	7 "	20,000	7 "	22,500
100	4 "	40,000	4 "	45,000

When a conductor composed of several wires is used the radiating surface in proportion to the cross-section of copper is increased. Each square inch of copper is provided with much more surface, thus subdivided than as a solid conductor, and the result is that the capacity of the copper for current is increased without overheating. The depth of winding as described in earlier articles also limits the heat and safe carrying capacity of the conductor. On the basis of 2,000 amperes per square inch of copper cross-section a table similar to the above could be constructed, but its value as a directive factor would not be of and consequence. Although the conductors with which armatures are wound may be stranded or subdivided into wires in multiple, still in spite of the effect of deep winding upon the insulation or external surface for radiation, the velocity with which the outer surface of the armature moves through the air will greatly modify any expected heat any probably diminish it. Therefore the load on an armature, although confined within the limits of a given ampere stream, is also limited by its emissive or radiative power.

A wire will only increase in temperature if the rate at which the heat is generated is greater than the rate at which it is radiated

The safe temperature at which an armature may be run depends upon the exposed area, the watts wasted and the peripheral speed

A magnet coil, in which the wire is stationary and wound to a much greater depth than ever occurs on an armature core, has a greater allowance made than that of the rapidly revolving surface.

Because of this fact a formula for the prediction of the temperature has been constructed, containing the conditions of peripheral speed, watts wasted and surface of radiation.

$$t^\circ = \frac{85 \times \text{watts}}{\text{surface} + \text{surface} \times \dfrac{\text{perip. speed}}{2\ 000}}$$

As stated symbolically the formula reads:

$$\text{Fahr. } t^\circ = \frac{85 \times w}{s\left(1 + \dfrac{v}{2000}\right)}$$

w = watts wasted in armature.
s = number of sq. ins. of radiating surface on armature.
v = peripheral speed in feet per minute.

As an illustration, with a set of conditions as the following, what is the temperature rise above the air?

w = 200.
s = 100 square inches.
v = 3,000.

$$t^\circ = \frac{85 \times 200}{100\left(1 + \dfrac{3000}{2000}\right)} = \frac{17{,}000}{100 + 150}$$

= 68 degrees.

Thus showing the applicability of the method and its somewhat assuring results.

A table might be drawn up on the basis of this formula for an armature having a peripheral speed of 3,000 feet a minute, but different surfaces for radiation and varying losses.

(At 3,000 feet minute.)

t° Fahr.	Watts wasted.	Surface sq. in.
34°	100	100
68°	200	100
68°	400	200
85°	1000	400

From the above table calculations can be partially saved, as the surface and watts are given in round numbers. The extreme rise in temperature allowed is from 50° to 75° Fahrenheit, and even this may be increased if the temperature of the engine-room be extremely low. Esson gives a rule similar to the above for peripheral speeds as follows:

$$t^\circ\ (c) = \frac{55\ w}{s\ (1 + .00018\ v)}$$

s = square inches.
v = peripheral speed in feet per second.
t° = centigrade degrees.

By observations conducted with the proper view to investigation with armature running at ordinary speeds, according to Esson "there is a rise of 35° Cent. if for every watt wasted 1.13 square inches be allowed." Kapp makes an allowance of 1½ square inches for each watt lost in the armature, although it can be well understood that an increased speed of rotation would sensibly decrease these areas. It is well within the scope of experience to state that it does not pay to crowd the radiative space allowed. If the areas for the escape of heat be allowed for, in many well-designed armatures the loss is usually such that even though such questions lacked consideration a natural adjustment takes place and the surfaces are found to be more than sufficient. A critical glance from an experienced designer determines at once these proportions and possesses the accuracy and surety of the most elaborate calculations.

(*To be continued.*)

THE USE OF STORAGE BATTERIES IN ELECTRIC LIGHTING.*

BY DR. FRANCIS B. CROCKER.

The function of accumulators is to receive electrical energy at one time or place, and to give it out at some other time or place.

The principal uses to which they may be put in electric lighting are the following:

1. To supply portable electric lamps.
2. To take up fluctuations and thus steady the voltage or current.
3. To furnish energy during certain hours of the day or night and enable the machinery to be stopped.
4. To aid the generating plant in carrying the heavier load, which usually exists for only an hour or two.
5. To make the load on the engines more uniform by charging the battery when the load is light.
6. To transform from a higher to a lower potential by charging the cells in series and discharging it in parallel, or *vice versa*.
7. To subdivide the voltage and enable a three or a five-wire system to be operated with a single dynamo.
8. To supply current from local centers or sub-stations.

Each of these applications will be considered separately in the above order.

1. *Portable accumulators.*—The accumulator is practically the only means of supplying portable electric lamps, or

* Topical communication presented to the meeting of the American Institute of Electrical Engineers, New York and Chicago, November 20, 1895.

those which are not connected to a dynamo even if they are stationary.

The primary battery is expensive and troublesome to operate, and it has never been commercially successful for electric lighting, except where only a few small lamps are required. Nor is there any other satisfactory primary source of electrical energy except the dynamo driven by mechanical power. It is therefore practically essential to adopt accumulators wherever portable electric lamps are used.

The serious drawback with portable accumulators is their great weight. For example, a standard size which weighs 100 pounds yields ten volts and five amperes, or 50 watts for ten hours, which is just sufficient to feed one ordinary incandescent lamp of 16 candle-power. This weight would be prohibitive in most cases in which the only way to carry the battery was by hand, but it might be allowable for lighting railroad trains, where the weight would not be so objectionable.

Their great weight would also discourage in most instances the use of accumulators for supplying lamps in places which are not connected to a generating plant, the batteries being carried back and forth from a charging station. This method might be resorted to on special occasions, such as a fete, to which ordinary commercial limitations do not apply, but for regular lighting it would be troublesome and expensive.

Small accumulators are used to feed miniature lamps for medical or dental purposes, in which case their weight is not a serious difficulty, in view of the importance of the work, and the small amount of energy required. Small batteries are also employed for theatrical lighting effects in which the lamps and batteries are carried by the performers when it is not convenient to supply lamps by a wire connection.

2. *Accumulators for preventing fluctuations*, due to unsteadiness in the driving power, are often applied successfully. A dynamo driven by a gas-engine, for example, may vary periodically in speed because of the explosive action of the gas in the cylinder, and a battery connected in parallel with the dynamo will have the effect of steadying the voltage. But improvements in design and construction tend to reduce unsteadiness of speed and by the use of a heavy fly-wheel, and an elastic connection between the engine and dynamo, the result is sufficiently satisfactory in most cases to make a battery unnecessary. An accumulator is generally installed in connection with a small gas-engine lighting plant to enable the engine to be stopped for a considerable portion of the time and thus save labor and attention, in which case the battery may also act to prevent fluctuations, but its principal function is the former one, which will be considered next.

A windmill electric-lighting plant absolutely requires an accumulator or some other means of storing energy not only to eliminate fluctuations in speed, which are constantly occurring, but also to bridge over the considerable periods of calm weather.

3. *Accumulators to enable machinery to be stopped* during certain portions of the day or night. The advantage of this application depends upon the fact that in almost every electric-lighting plant there are long periods during the day and late at night when the number of lamps lighted is so small that it may not pay to run the generating machinery.

This plan also allows the machines to rest and cool down, which greatly facilitates cleaning and repair. In a hotel, residence, or on board of a yacht it may be very desirable to stop the machinery and avoid the vibration and noise during the night. On the other hand, the addition of an accumulator to an electrical plant renders the latter heterogeneous, since the battery and its management differ so radically from the machinery and the handling of the same. It must also be remembered that the total investment is increased by the cost of the battery and its accommodation, because the generating plant is perfectly able to carry the load put upon the battery, since by hypothesis this load is a light one. Hence the machinery might be run all the time, in which case the battery would be entirely unnecessary and sufficient rest for the machinery could be secured by using different machines for the periods of light load on successive days. These statements are based upon the supposition that the battery is not used to help the dynamos at the time of maximum load, since this case will now be considered separately.

(*To be Continued.*)

RECEIVER APPOINTED.

J. D. Bennett, of Brooklyn, has been appointed receiver of the Rockaway Electric-Light Company, Rockaway Beach, N. Y. The company's liabilities are $100,000, and there are only $15,000 in assets.

REDUCED FARES IN BROOKLYN.

It is reported that the Nassau Electric Railroad in Brooklyn will reduce the fare on its lines to 4 cents. There promises to be close competition between this road and the Brooklyn Heights road.

DEATH OF MR. MUIRHEAD.

John Muirhead, the well-known English telegraph engineer, is dead.

ALTERNATING CURRENTS FOR RAILWAYS.

Arthur J. Farnsworth, in an article in the *American Engineer and Railroad Journal*, speaks very hopefully of the availability of the alternating current for railway work.

After referring to the continuous-current apparatus, and particularly to the usual objections urged against that "necessary evil,"—the commutator—he continues :

"On the other hand it may be urged that most of our alternating-current machines have commutators also in addition to collecting rings. That is very true, but commutators and collectors are by no means necessary in the design of a good alternator. At present most manufacturers make use of them either because they are convenient or in order to avoid conflicting with present patents. Alternating-current generators can be bought today of thoroughly reliable manufacturers, and be possessed not only of no commutators or moving contacts, but which have no moving wire as well. What could be more simple than a generator whose only moving part is a mass of laminated iron turning about self-oiling bearings? Such a device will evidently call for the minimum initial expenditure as well as the minimum expense of operating.

"Passing from the generating plant to the feeders we find that with the continuous current system we are not permitted to maintain a voltage much above 500 by reason of the danger to life. Were this barrier removed we would find that it is impossible to build a successful commutating machine for high voltages. This means that for operating a large system the current is necessarily very great, and the feeders, consequently, very large. If the road is long we are under the necessity of dividing the generating plant into sections located along the route, on account of the large loss of power in long feeders. In any case, the generators must be over-compounded to a considerable degree in order to keep the voltage at the trolley reasonably constant.

"In view of these considerations we readily see: 1. An enormous outlay is necessary for copper. 2. The generating plant will be more expensive to install and operate than if it were all contained in one building. 3. The generators must be operated part of the day, at least, with a low efficiency and consequently large expense.

"Granting for the moment that the system can be operated by alternating currents without altering the existing lines, we find that we immediately have an immense advantage. The gain will be threefold. The loss of power in the transmission lines and, consequently, the expense of operating may be greatly decreased. The initial expense of installing the line, and, therefore, the fixed annual charges for interest is much less. A practically uniform voltage may be maintained upon the trolley, and this can be made as small as desirable without greatly increasing the expense, either of operating or installing. All this may be accomplished with extreme simplicity.

"The generators, being without commutators or sliding contacts, may be built to deliver a very high voltage, say 10,000, to the lines without danger to the attendant or apparatus. Such machines are now actually built and guaranteed by the manufacturers. With 10,000 volts instead of 500, the current necessary in order to deliver the same amount of energy to the lines will be only one-twentieth of its former amount. As the loss of power in the lines at any instant is C^2R, it is evident that by using the same set of feeders we may decrease our transmission loss by this means to one four hundredth of its present value.

"At the present time it is probably this transmission loss more than any other thing that has thus far made very long electric railways a practical impossibility. It is impossible to employ very high voltages with the continuous current system, owing to the impossibility of using commutating machines. A combination system might be employed in some cases today with advantage, using a high voltage alternating transmission and transforming by the use of rotary converters into a low-pressure continuous current for supplying the trolley. Such a system has the disadvantage that an attendant will be required to operate each converter, it being moving machinery and constituting in effect a small sub-station. Such converters are also far more expensive to construct and operate than the stationary transformer, and it is obvious that the method is at best a makeshift, and that the pure alternating-current system will prove the ultimate method of operating such lines.

"In using a pure alternating system we must remember, however, to deduct from the apparent gain we noticed above a small amount representing the losses in the necessary transformers, because in this case, as well as in the use of continuous currents, a high voltage in the trolley is not permissible. It should also be mentioned that if the road is very long the transformers along it can be wound in a progressively changing ratio, which will compensate for the drop of potential in the primary mains and keep a practically uniform pressure on the trolley from end to end of the route.

"But we have yet to prove that the present lines *can* be employed for operating a pure alternating-current system, for, as yet, nothing has been said concerning the car equipment. That is the only difficult feature of the problem as it stands today, and engineers have long been familiar with the considerations outlined above. It is in the motor, however, that the alternating system *should* especially outclass its rival, and it is the motor that has thus far given the greatest trouble to electric railroad men.

"The alternating current motor of today is unsuited for railroad purposes for two reasons. First, it is not very efficient unless running at constant speed. Second, it is not self-starting unless wound for two or more phases, which would necessitate, for railroad use, the employment of at least two trolley wires. This can hardly be allowed except for conduit roads. Otherwise, the alternating motor fulfils to a nicety every requirement of a perfect railway motor. It has no commutator or brushes, and nothing to replace or get out of order. Its armature, being simply a mass of iron and copper with no insulation whatever, has nothing to burn out. If properly built, it is capable of running perfectly, if need be, under water, and perhaps most important of all, it is universally acknowledged to be the cheapest and most reliable motor that can be produced."

In conclusion Mr. Farnsworth states: "The next few years will undoubtedly develop changes and perfections in alternating apparatus that will make the alternating current railway all that could be desired."

TURKISH VS. PERSIAN TELEGRAPH POLES.

An amusing story is told regarding the construction of a telegraph line from Bagdad, in Asia Minor, to the Persian capital of Teheran. The frontier line between Turkey and Persia was so indefinable that a track of no less than 17 miles of land over which the telegraph would have to be carried was in dispute, each of the two countries claiming the right to its possession. Now, the engineering stores supplied to the Turkish government differed from those supplied to the Persian government. The former had wooden telegraph poles, the latter iron ones. The Persian government, in their jealous hatred of the Turks, feared that if wooden poles were erected across the disputed territory, posterity would regard them as proof that that the territory was Turkish. On the other hand the Turks objected to iron poles being used, lest in the far future they should be adduced by Persia as evidence that the land was hers. The way in which the superintendent of the work contrived to get out of the difficulty did credit to his ingenuity and resource. He alternated the wood and iron poles for the whole 17 miles.—*Electrical Engineer*, London.

THE ELECTRICAL EXHIBITION.

Mr. Clarence E. Stump, who is so well known in the electrical field, has been appointed general manager of the Electrical Exposition, which is to be held in New York City, commencing May 4 and continuing until the first of June, 1896.

Numerous inquiries for information regarding space and other details are daily being received by the management, and a large number of prominent manufacturers have already closed contracts, while many additional firms have signified their intention to make extensive exhibits. The success of the enterprise is assured, and all indications point to the largest and most interesting display of electrical apparatus and supplies ever made in this country.

ELECTRICAL RESONANCE.

Prof. M. I. Pupin, of Columbia College, will deliver a lecture on "Electrical Resonance and Alternating Current" before the Department of Electricity, Brooklyn Institute of Arts and Sciences, on the evening of January 3, 1896. The lecture will be illustrated.

ELECTRIC LIGHT IN HINDU TEMPLE.

The electric light is to be introduced into the Sivan Hindu Temple, at Kochicadde, Ceylon.

NEW EDITION OF DYNAMO-ELECTRIC MACHINERY.

The fifth edition of Dynamo-Electric Machinery, by Silvanus P. Thompson, is now ready. This new edition has been rewritten and thoroughly revised throughout, and is an entirely new book. It contains 835 pages and 19 folding plates. Price, $5.50. Electrical Age Publishing Co., New York.

FORECLOSURE SALE.

Judge Jenkins, Milwaukee, Wis., has signed a decree of sale in the foreclosure proceedings against the Milwaukee Street-Railway Company. The plaintiffs to this action are the Central Trust Company, New York; the North American Company, Nelson Robinson, and the Milwaukee Street-Railway Company, of New Jersey. F. M. Hoyt is appointed special master to carry the decree into effect.

HOW TREASURE IS TRANSPORTED IN CHINA.

We have heard much, especially of late, of the diverting of public treasure to private gain by Chinese officials of all ranks, and the pitiable evidence of it in the failure of the Chinese army and navy to be ready for the inevitable struggle with Japan is too recent and convincing to be disputed; but on the other hand we can only wonder at the power of this law of responsibility which, in such a land, enables the remotest province to transport its dues to Peking in solid silver, by the simplest means, without loss by the way and without the protection of a single soldier. Nothing impresses one more with the absoluteness of this power as applied to transportation than to meet a line of pack-mules, horses, or camels loaded with silver bullion. The silver is usually confined in rough logs of wood that have been split, hollowed out and then bound together, and each load is marked with a little flag of imperial yellow, stating the amount and destination. That is all the protection there is except the ordinary drivers, who carry no weapons and are attended by no guard. In what other land on the face of the globe could the same be done?—["Responsibility Among the Chinese," by Prof. C. M. Cady, in the January *Century*.]

Possible Contracts.

WESTPORT, MO.—A. S. Marley, city attorney, may be addressed for information concerning the issuance of $75,000 worth of bonds for electrical plant, etc.

NEW BRIGHTON, S. I., N. Y.—The New Brighton Trustees have approved the contract with the Thomas syndicate for the construction of an electric road upon Castleton avenue, West New Brighton.

FRONT ROYAL, VA.—A company will probably be organized to construct a trolley line from Culpeper to Front Royal.

TRENTON, N. J.—American China Development Company has been incorporated by Frank Trenholm, of New York, N. Y., E. H. Lyons, Greenwich, Conn., and S. S. Walters, of Jersey City, to construct and operate telephone and telegraph lines, etc. Capital stock, $1,000,000.

MOODUS, CONN.—Moodus people are talking of raising capital to build the Moodus, Marlborough and Glastonbury Electric Road to connect at South Glastonbury with the Hartford line.

NEW YORK CITY.—R. H. Macy & Company have leased the building of the Colonial Real Estate Association, which will be erected at 53 and 57 West 14th street. The building will cost $250,000.

HARRISBURG, PA.—Plans for the new building to be erected by the Harrisburg National Bank have been prepared by Architect John C. Smith.

PARKERSBURG, W. VA.—Parkersburg Academy of Music, recently burned, will be replaced by a $100,000 auditorium.

MEMPHIS, TENN.—M. L. Weathers, Randolph Building, has prepared plans for a five-story building to be erected by the I. O. O. F. Society, at an estimated cost of $50,000.

PHILADELPHIA, PA.—Estimates are being made for the erection of a two-story extension to the plant of the Brush Electric Light Company, on Johnson street.

CASEVILLE, MICH.—Caseville capitalists have organized an electric-lighting company, and it is the intention to put up a plant to furnish lights for both public and private use.

NEW YORK.—The New York Life Insurance Company will put up a new 12-story building on the site of the present building, corner Broadway and Leonard street. McKim, Mead & White, 150 Fifth avenue, are the architects. The new building will cost $1,000,000.

New Corporations.

PITTSTON, PA.—The Pittston People's Electric Railway Company was chartered in Harrisburg. Capital, $50,000. The line is to be eight miles in length, and is to be constructed between Pittston and Wilkesbarre. Directors, Joseph H. Glennon, West Pittston, Joseph C. Reap, Michael J. Langan, Pittston, and John T. Lenahan of Wilkesbarre.

ALBANY, N. Y.—The Bath and Lake Keuka Railway, to operate a street-surface electric road, ten miles long, from the Soldiers' Home, Bath, to the village of Hammondsport. Capital, $100,000. Directors, Israel A. Kelsey, of West Haven, Conn.; John T. Prince, of Boston; John T. Prince, jr., C. L. B. Tyler, F. H. Viele, George E. Tyler, Charles M. Hyde, E. J. Carpenter, John L. Miller, of Corning.

Telephone Notes.

NEWTON, KAN.—The City Council has granted a telephone franchise to A. R. Champlin, and telephones will be in operation here by June 1.

DEADWOOD, S. D.—A petition was presented from George W. Cornwell, of Sturgis, for permission to construct telephone lines through the streets and alleys of the city. The matter was referred to the Committee on Fire and Police.

CHESTER, PA.—There will be a meeting of the Deleware County Telephone and Telegraph Co. for the purpose of considering the franchise in the city. The company will appoint a committee to confer with the Councilmen, and give them some idea of what they will be able to accept in the shape of an ordinance.

UNION BRIDGE, MD.—The Western Maryland Telephone Co., of Carroll County, has obtained a franchise from the corporate authorities of Union Bridge for the erection of its lines in that place and is to establish an exchange.

KALAMAZOO, MICH.—The Kalamazoo Telephone Co. has been incorporated by C. H. McCurrin, William A. Doyle, Henry F. Hodgeman, Charles A. Peck and others. Capital stock, $30,000.

Trade Notes.

The Rogers Iron Works, of Oakland, Me., has recently been incorporated with a capital of $300,000, to manufacture a number of new patents. This company will continue the manufacture of the celebrated Pease planer, thirty different varieties of boring machines, lathes, and a complete line of general tools for machine shop equipment, pulp mill machinery, etc. Among the new specialties is an absolutely frictionless "ball bearing," to be used on bicycles, carriages, shafting and for various other purposes, heavy contracts for which are now pending.

ELECTRICAL and STREET RAILWAY PATENTS

Issued December 24, 1895.

551,755. Switch-Operating Mechanism. John P. Coleman, Swissvale, Pa., assignor to the Union Switch and Signal Company, same place. Filed Feb. 21, 1895.

551,757. Electrically-Operated Elevator. Fred B. Corey, Boston, Mass. Filed May 13, 1895.

551,781. System of Electrical Distribution. Thomas F. Mullaney, Worcester, Mass., assignor to the General Electric Company, of New York. Filed Sept. 24, 1895.

551,785. Electric Brake. William B. Potter, Schenectady, N. Y., assignor to the General Electric Company, of New York. Filed Mar. 30, 1895.

551,786. Lightning-Arrester. William B. Potter, Schenectady, N. Y., assignor to the General Electric Company, of New York. Filed Aug. 31, 1895.

551,790. Machine for Connecting Electric Conductors. Harlie J. Savory, Somerville, Mass. Filed Apr. 17, 1893.

551,793. Car-Coupling. George D. Schultz and Charles Gudgell, Independence, Mo. Filed Apr. 25, 1895.

551,795. Electrogalvanic Belt. Samuel J. Spalding, Canton, Ohio. Filed May 9, 1895.

551,799. Electric-Arc Lamp. Elihu Thomson and Charles E. Harthan, Swampscott, Mass., assignors to the General Electric Company, of New York. Filed May 9, 1895.

551,802. Car-Fender. William M. Watts, Philadelphia, Pa. Filed June 29, 1895.

551,805 Car-Fender. Charles P. Woodruff, Brooklyn, N. Y. Filed Aug. 14, 1895.

551,809. Converting Simple Into Polyphase Alternating Currents. Charles S. Bradley, Avon, N. Y. Filed June 11, 1892.

551,810. Alternating-Current Motor. Charles S. Bradley, Avon, N. Y. Filed Sept. 12, 1893.

551,820. Mechanism for Operating Elevator-Controlling Mechanism. Frank E. Herdman, Winnetka, Ill. Filed July 10, 1895.

551,851. Wheel-Fender for Street-Cars. William R. Derr, Baltimore, Md. Filed Apr. 26, 1895.

551,856. Commutator-Brush. Caleb C. Dusenbury, Lake Mahopac, N. Y. Filed June 10, 1895.

551,863. Alternating-Current Machine. Maurice Hutin and Maurice Leblanc, Paris, France, assignors to the Société Anonyme pour la Transmission de la Force par l'Electricité, same place. Filed May 1, 1895. Patented in France, June 11, 1892, No. 222,287.

551,880. Electrical Eye-Cup. Theodore B. Wilcox, Newark, N. J., assignor to Eli Baldwin, New York, N. Y. Filed Jan. 10, 1895.

551,904. Car-Fender. Adolph Lutz, Brooklyn, N. Y. Filed Apr. 25, 1895

551,920. Electric Stop-Motion for Machines for Preparing Silver. William P. Canning, Lowell, Mass., assignor to the Lowell Machine Shop, same place. Filed June 19, 1895.

551,930. Electric Railway-Train Signaling. Walter S. Greene, Covington, Ky. Filed Sept. 3, 1895.

551,942. Electric Latch Apparatus for Semi-Automatic Operation of Railroad-Signals. Harry C. Barnes and William W. Slater, Oakland, Cal. Filed Mar. 21, 1895.

551,947. Electric Telegraph. William H. Cooley, Brockport, N. Y. Filed Mar. 23, 1889.

551,948. Electric Telegraph. William H. Cooley, Brockport, N. Y. Filed Apr. 18, 1893.

551,951. Automatic Temperature-Regulating Apparatus. Charles L. Fortier, Milwaukee, Wis., assignor to the Johnson Electric Service Company, same place. Filed May 8, 1893.

551,959. Thermostatic Regulating Device. Charles A. Hale, Cleveland, Ohio, assignor to the Time Electric Company, same place. Filed Jan. 8, 1894. Renewed Feb. 18, 1895.

551,972. Car-Fender. Charles L. Klauder, Philadelphia, Pa. Filed Nov. 23, 1894.

551,982. Station Potential-Indicator. Ralph D. Mershon, Pittsburgh, Pa. Filed Apr. 29, 1895.

551,996. Pedo-Electric Trolley. Robert T. Oney, Charleston, W. Va. Filed Mar. 27, 1895.

551,998. Electric Signal. Eugene M. Phelps and Archibald T. Sampson, Lynn, Mass., assignors, by mesne assignments, to the Farmer Electric Company, St. Louis, Mo. Filed Oct. 8, 1891.

552,001. Underground-Current Supply for Electric Railways. August Rast, Nuremberg, Germany. Filed Mar. 29, 1894. Patented in Germany Oct. 24, 1893, No. 74,641.

552,036. Material for Incandescent Conductors. Ludwig K. Böhm, New York, N. Y. Filed Nov. 5, 1891.

552,053. Electrical Switch-Operating and Signal Apparatus. Justin Dutrey, New Orleans, La. Filed May 25, 1895.

552,057. Circuit Closer and Breaker. John R. Farmer, St. Louis, Mo., assignor to the Farmer Electric Company, same place. Filed Jan. 25, 1895.

552,059. Art of Making Armored or Compound Tubes. Edwin T. Greenfield, New York, N. Y. Filed May 16, 1895.

552,060. Armored Tube or Conduit. Edwin T. Greenfield, New York, N. Y. Filed May 16, 1895.

552,073. Store-Service Apparatus. John C. Reuter, Englewood, Ill. Filed Mar. 5, 1895.

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CONTENTS.

AMERICAN PROFESSORS HONORED.

At the centenary of the Institute which was celebrated in Berlin, on January 4, Prof. Henry A. Rowland, of Johns Hopkins' University, Baltimore, was created an officer. Profs. Simon Newcomb and Alexander Agassiz were also honored in like manner, and Adolphus Hall was created a Chevalier of the Legion. All these gentlemen are corresponding members of the Academy of Sciences.

LIGHT THAT PENETRATES OPAQUE SUBSTANCES.

The New York *Sun* on January 7 published an interesting story in a special cablegram from London, to the effect that Prof. Routgen, of the Würzburg University, Vienna, had discovered a light which, for the purposes of photography, will penetrate wood, flesh and most other organic substances. The professor, the despatch states, has photographed metal weights which were inclosed in a wooden case; also a man's hand, showing only the bones, the flesh being invisible. The light used for the purpose is that emitted by a Crooke vacuum tube. "In contrast with the ordinary rays of light," the correspondent continues, "these rays penetrate organic matter and other opaque substances just as ordinary rays penetrate glass." The professor also succeeded in photographing hidden metals with a cloth thrown over the camera. The rays of light from the tube penetrated not only the wooden case containing the metals, but the fabric in front of the lens. Prof. Routgen is already using his discovery to photograph broken limbs and bullets in human bodies.

DANGER SIGNALS ON THE BRIDGE.

Undoubtedly many accidents are avoidable, especially on railroads, and it frequently happens that the utmost endeavors are not put forth to avoid an accident until after one has occurred. Then the managers, or those responsible, seem to realize that their plans were inadequate. It is not always possible, of course, to provide for every emergency; but the experience of the past has taught us a great deal, and with this experience as a guide many accidents can be guarded against. It is an open question whether the Brooklyn Bridge trustees have in the past profited by the long experience of other railroads. If they had, and they had done their whole duty, the fatal collision on the bridge a few weeks ago might not have occurred. Since then there has been a great bustle and show of anxiety on their part to adopt a reliable signal system in order to avoid such accidents in the future—all after the sacrifice of human life. During the past week or two experiments have been made, and evidently with successful results, with a telephone system by which communication can instantly be had between any train on the road and the train dispatcher, and *vice versa*. This is good as far as it goes, but we think it does not completely meet the requirements. A system that provides for the setting of a danger signal in the section behind a stalled train to immediately warn a train on that section of the danger ahead is what is needed. To telephone to the dispatcher from a train that has stopped on the road, and then for him to telephone the train behind would manifestly consume a good deal of time; a collision might occur in the interval. Mr. E. B. Dunn, of the Weather Bureau in this city, has devised a system of signals which is better than the telephone, and which, when properly developed, would, it seems to us, answer the purpose very well. We give on another page a brief description of his plan. Such a system could be made entirely automatic, and there is no more favorable situation for the operation of an automatic contrivance than on the bridge. The bridge trustees should examine the thing carefully, and, if it has the merit that it seems to have, they should adopt it forthwith.

PRINCIPLES OF DYNAMO DESIGN.

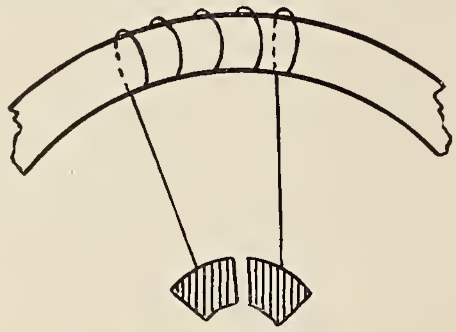
BY

Newton Harrison, E.E.

(*Continued from page 8.*)

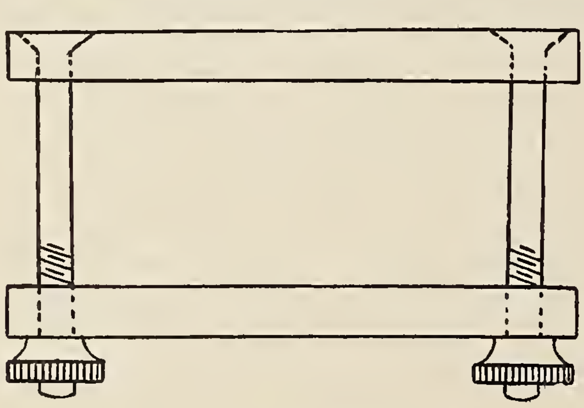
Windings.—There are two general classes of winding with which most engineers are very familiar. They are the simple drum or Siemens winding and the ring or Gramme. Of Gramme winding but little need be said, as its simplicity does not necessitate lengthy explanations.

In this type of winding there is, as a rule, one coil to each commutator section. There are, therefore, as many



GRAMME WINDING.

coils or sections on the ring as there are segments on the commutator. The construction of the ring does not always require that this should be the case, however. Two sections on the armature may be connected to only one commutator segment. The Crocker and Wheeler Co. use a toothed ring armature, with half as many slots as there are commutator segments. This requires the use of two coils in each slot, and thus simplifies the work. Where a Gramme armature is used in connection with a multipolar field a system of cross-connecting is in vogue. This may be extended to the commutator instead, and thus require as before the ordinary connections of the Gramme without any additions. The inside wire of a Gramme ring is probably inactive. It can hardly be called wasted, as its presence is as necessary as the end wire on a drum or, in fact, the connecting wires on any style of armature. Furthermore there are certain gains attendant upon the use of a ring armature which have always made it characteristic in practice. The taping of the armature core is necessary; at least its surface must be coated with an in-



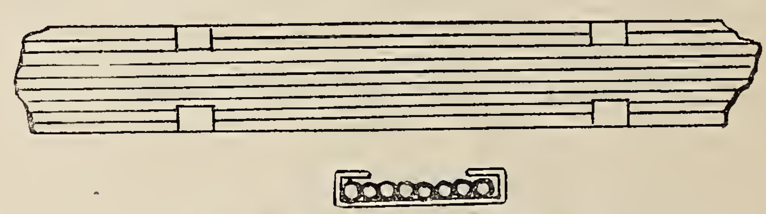
CLAMP.

sulating compound into which the wire will not sink when wound.

Stiff cotton goods well saturated with shellac and dried in a gentle heat, or a covering of oiled paper, will protect the wire wound upon the core from grounds. Stiff paper boiled in linseed oil and allowed to dry thoroughly will prove a useful substitute for tape. The coils, if wound upon a *smooth* core ring, are started by winding each within a given spacing and between two wooden or brass clamps, which limit the size of each coil. Each layer is shellacked and packed tightly and securely. Flabby or baggy winding is always a source of trouble and can never be remedied except by rewinding. Each section is filled in and separated from the next by a thin flange of vulcanized fibre, or any other appropriate means. When a toothed ring is to be wound the clamps are unnecessary, and the separate slots are flanged and taped in a thorough manner to protect from grounds. Binding wires wound over all in either two or three bands will protect the coils from flying out. A strip of mica underneath the binding wires will insulate them from the wire beneath, and small strips of tin placed under them at right angles will prove extremely beneficial if their ends are bent over the wire and solder applied.

The winding of a drum armature offers some further complications. Owing to the fact that the wire packs at the ends, several styles of winding are adopted for the purpose of eliminating as far as possible this difficulty. Were each section wound in full, layer after layer, the thickness of the winding at the ends would increase very rapidly as each section was completed. If each coil around the drum was one-half an inch thick and 12 coils were wound on it, there would be six inches of wire packed up at each end of the core.

To distribute the wire so as to reduce this swelling of the ends, and still retain the proper number of inductors in each section, is accomplished in the following manner: The shaft which passes through the centre of the core must not have one entire coil wound on *one* side of it, for that would give a thickness of wire to start with equal to the depth of the coil; and each coil as it is wound successively upon the last would in the end produce an enormous bunch at each extremity of the armature. By winding the first layer of the coil, however, upon the armature as usual, and winding the second layer so that its turns pass upon the other side of the shaft, the layers are alternated and



BINDING WIRE FOR ARMATURE.

only half the thickness of wire remains at the ends that exists in the section.

A coil one-half an inch deep would therefore occupy at the ends but one-quarter of an inch of thickness; and 12 coils one-half an inch deep, which would by the first method occupy a space of at least six inches at the ends, by this method call for little more than three inches. Allowance for insulation at the ends is necessary, as each layer is separated from the other by light canvas, cheesecloth or something equally available.

There are a variety of methods by which the end winding of a drum armature is kept reduced, and of them all the best is undoubtedly the style adopted by Crompton and Swinburne, and Eickemeyer.

The winding is either of copper strips or of separate coils pressed into form before use and then simply arranged around the armature core. A square head results at each end of the armature, and a neat and particularly compact winding is the result.

(*To be continued.*)

THE NORTH CHICAGO STREET-RAILWAY PAYS A BIG DIVIDEND.

A despatch from Chicago states that the directors of the North Chicago Street-Railway Company, on December 28, declared a dividend of 20 per cent. on the $5,500,000 capital stock of the company. Ten per cent. of this, or $550,000, will be given as a stock bonus, and 10 per cent. in six per cent. debentures of the company. The directors also voted an increase of $550,000 in the capital stock of the company, for which stockholders will be allowed to subscribe pro rata at par.

The stock sold on the same day on the Exchange at 308½, and figured on a basis of 300 the stockholders get $3,000,000 in bonuses and rights.

ELECTRICAL COMMUNICATION BETWEEN MOVING TRAINS.

M. De La Touche, the engineer of the Western Railway of France, has directed attention to the following means of securing communication between train and train as each pass on their journey, the object being to preserve a given and suitable space between those travelling on the same pair of rails. The rails are, in the first instance, electrically connected, so as to insure perfect electrical continuity, each rail, however, being maintained, as far as possible, insulated from the other. In order to effect this the rails are at their point of junction electrically bonded, or connected together. On each engine is arranged a small dynamo, A (fig. 1), driven from the axle of one pair of the wheels, as also a set of accumulators to provide the necessary current when the dynamo is still, or out of circuit.

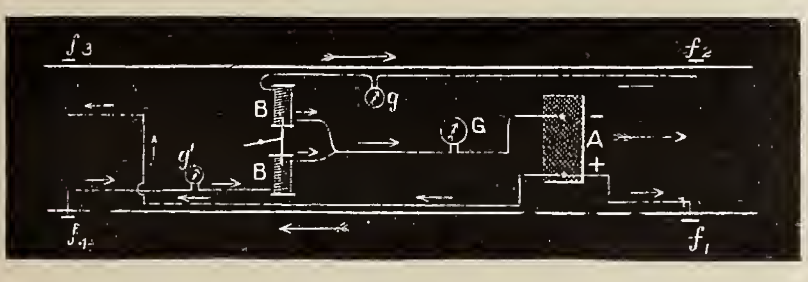


FIG. 1.

These cells, it is said, are of sufficient capacity to provide current for two hours, and the dynamo is of two horsepower. The connections are such that the dynamo, or the batteries, as the case may be, shall send a current to the rails by means of roller connections, f_1, f_2, f_3, f_4, attached to the front and rear of the locomotive. The current thus sent into the rail is employed to actuate certain apparatus in near trains, or, in conjunction with that from other near trains, the apparatus on the locomotive with which we are dealing.

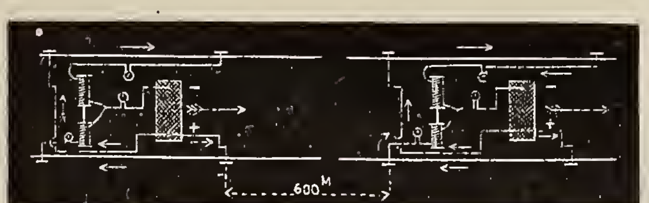


FIG. 2.

This apparatus is termed the warning apparatus, and consists of two electro-magnets or coils, which, by the aid of levers, operate the whistle or automatic brake. Three galvanometers (fig. 1), are placed in circuit. One, G, to indicate if the current is flowing; the others, g and g^1, to indicate to the driver if within the vicinity of danger. The arrangement will be made clear by reference to the diagrams. Fig. 2 represents two trains travelling in the same direction; fig. 3 two trains approaching one another. As the trains approach each other, so the current traversing the rails is augmented by the presence of the

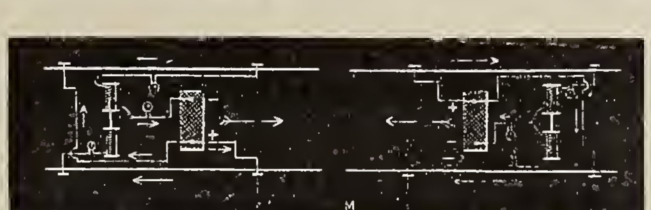


FIG. 3.

approaching train, thereby actuating the galvanometers, g, and g^1, and indicating to the driver not only the direction in which the train is approaching, but the approximate distance it is off. It is said that a warning can thus be conveyed a distance of from 600 to 1,000 metres, and that the system is applicable to the operation of gates at level crossings, or signals. It is clear that such apparatus, placed on a locomotive engine, would be subject to very rough treatment, and we fear that the indications on the galvanometers would be liable to great fluctuations, due to the loss of current and variable connections.

THE FLEMING ALTERNATING ARC LAMP.

In design, workmanship and operation this lamp is claimed to be the best that can be produced. The mechanism has the fewest possible parts, all of which are made as strong as possible, consistent with proper proportioning of the strains. A view of the inside mechanism of the lamp is shown in Fig. 1.

The lamp is positive in its action, starting up on the normal amount of current, which prevents the flickering of incandescent lamps on the same circuit. It cannot overfeed, and will not, therefore, burn out the coil or blow

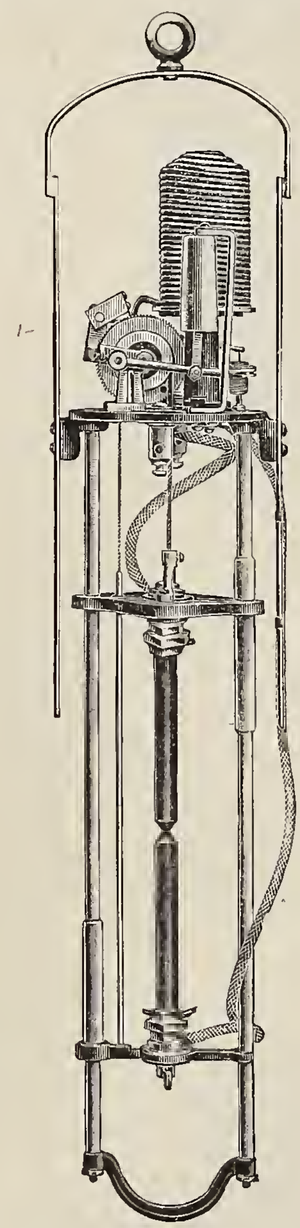


FIG. 1.

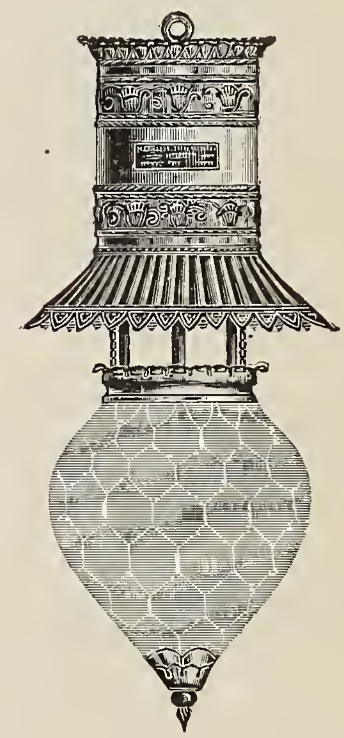


FIG. 2.

the fuse. It will burn on any current of sufficient frequency to maintain an arc without flickering.

The Fleming lamp is designed to burn on circuits of from 28 to 33 volts, and is practically noiseless in its operation. It is, besides, easily trimmed.

Fig. 2 shows a Fleming lamp of rich finish. These lamps are made in polished brass or bronze, and are excellently adapted for situations calling for lamps of ornamental design.

These lamps are made by the Fleming-Spence Electric Co., 652–660 Hudson street, New York City, and we understand they are meeting with much favor.

GOT A CHANCE TO EAT A DINNER.

The officers and directors of the Metropolitan Telephone and Telegraph Company held their "first annual dinner" last Saturday night at Madison Avenue Hotel. The affair was a great success and will probably be repeated annually.

Among those present were U. N. Bethell, general manager of the company, F. A. Baker, H. G. Bates and H. L. Webb.

DEPARTMENT OF ELEMENTARY EDUCATION.

BY THE EDITOR.

[*Note.—Any one is invited to ask questions on any point that is not made clear in these articles. Suitable explanations will be cheerfully given under the head of "Answers to Inquiries."*]

ELECTRIC BELL CIRCUITS.

(*Continued from Page 6.*)

The wiring of a finished building requires different treatment. The wires may be run perpendicularly between the walls, by dropping them from the higher point to the lower one and fishing for the dangling ends through the proposed outlet. They cannot be run horizontally in that way, of course, unless the flooring or baseboard is removed for the purpose. The fishing method is uncertain, however, and unless there is objection the wires are usually run along the baseboards, and around window and door-casings, on the outside surfaces. When wires are run in this way tacks must always be used to make a neat job, and to keep the wires in the grooves, which usually form a feature of decoration of woodwork. The object is, of course, to render the wires as unnoticeable as possible.

In order that the reader may understand how to instal a simple bell circuit, let us assume that it is desired to ring a bell by a push-button at the front door. The push-button is usually placed on the right-hand door casing. The bell should be so located that it can be heard in any part of the house. Generally it is placed at the end of the hall nearest to the kitchen, where the servants can surely hear it; or it may be placed in the kitchen. In any event it should be placed near the top of a door or window casing, or on the wall, if more convenient. It should be located high up, out of the way, as it very rarely requires any attention.

"Where shall the battery be placed?" is the next question to settle. It is important that it should be in a *dry* place, and, if possible, where it will not be subject to extreme heat or cold. But have it in a *dry* place, at all events.

It is needless to say that the battery should be out of the way. The cellar is a good place, if it is dry, and a good plan is to nail two or three boards to the floor beams at the most convenient place in the cellar. These boards form a shelf on which the battery cells may be placed, the space between the shelf and the flooring above being sufficient to accommodate the battery; such space cannot be used for anything else, and is excellent for battery purposes, providing the location is otherwise favorable. The battery in such a place is readily accessible and at the same time entirely out of the way.

Batteries are frequently placed in closets, on shelves and on the floor, but there are objections to such locations, and if it is possible to find a more appropriate place for the battery it should be done.

Of course an inflexible rule cannot be laid down for all cases; the course to be pursued in each must necessarily be determined by the existing conditions, keeping in view, however, the objects above referred to.

Having located the places for push-button, bell and battery, let us proceed to run the wires, starting, say, from the battery.

We will assume that we are to run a short, simple circuit, with one bell, on push-button and, say, two cells of battery. Such a circuit is planned in detail in Fig. 1. This diagram is very complete and illustrates many points, and we shall see as we proceed.

There being two cells of battery, one cell must be connected to the other in a certain way. The positive (carbon) pole of one cell must be connected to the negative (zinc) pole of the other by a short piece of wire. This connection between the two cells leaves the negative pole of the first cell and the positive of the second to be connected with the wires running to the bell and push-button.

In connecting up a battery it makes no difference whether the positive or negative pole is on the bell side or the push-button side—the current will flow either way; the only thing to provide is a positive pole and a negative pole for the reception of the main wires.

In case of more than two cells the same rule is followed in connecting the separate cells to form one battery; that is, connecting the zinc of the first to the positive of the second, the negative of the second to the positive of the third, the negative of the third to the positive of the fourth, and so on to the last cell.

In the diagram the positive pole of cell *A* is connected to the negative of cell *B*.

Now, starting from the positive of cell *B*, let us run our first wire, which in this case is to one of the push-button connections. In starting to run this wire the battery end must be bared of insulation and cleaned, in the same manner as before, and connected firmly to the carbon of cell *B*. The proper length of wire may be cut off from the bundle to facilitate handling. The wire is then led to the push-button, being tacked in place whenever possible, every few feet. The end of the wire is then bared and cleaned and connected to one "terminal" of the push-button, by twisting it around the screw and tightening the screw.

Now connect the first end of another length of wire (to run from the push-button to the bell, with the other terminal of the push-button and lay the wire to the bell, the end being connected firmly to one binding-post.

From the other binding-post of the bell run a wire to the zinc pole of cell *A*, and after having made all the con-

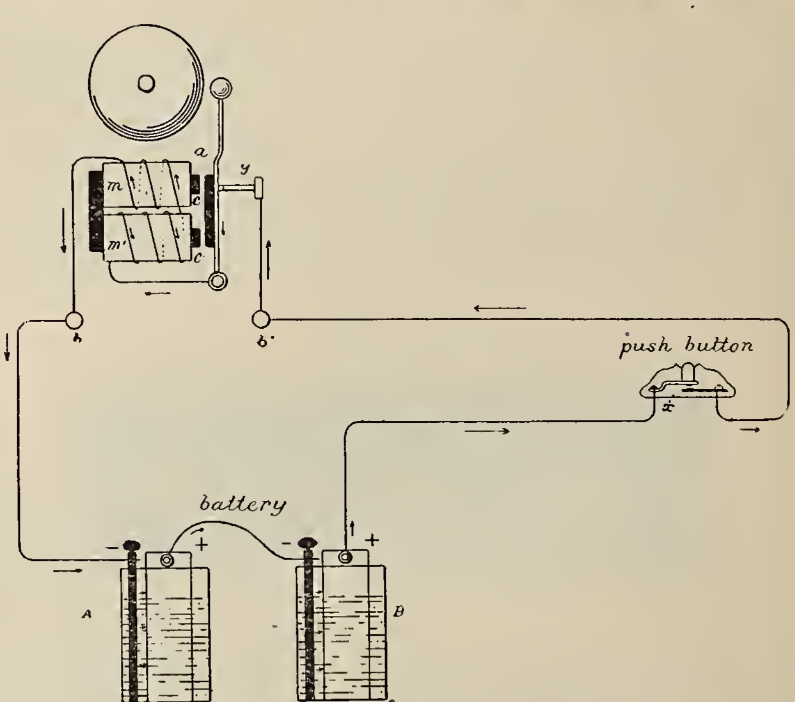


FIG. I.—SIMPLE BELL CIRCUIT.

nections good and firm the circuit is all ready for operation.

In most cases the wires can be run close together and parallel to each other for a greater part of their length.

Having thus outlined a bell circuit, let us consider what actions take place when we close the push-button. The current starts from the + (positive) pole of cell B and flows to the push button, and, assuming that the push is closed (at the point X) the current flows on past binding-post b′, through the closed contact points y, through the hammer rod to the magnets, around the magnets m′ and m, past binding-post b to the — (negative) pole of cell *A*; thence through the liquid of that cell to the + pole, thence by the short wire to the — pole of cell B, thence through the liquid of that cell to the starting-point. The moment the current is turned on by closing the push-button the magnet cores c and c′ become magnetic and attract the "armature," a, towards them. This attraction causes a separation of the contact points at y, thus interrupting the flow of current. When the current stops the magnetism of the cores ceases and the armature, being no longer attracted, flies back, again closing the contact points y. This re-establishes the current; the cores again become magnetic; the armature is drawn towards them and the circuit is again broken at y, only to be closed again by the return of the armature to its original position after the magnetic attraction has ceased. This cycle of operations is repeated very rapidly, which causes the vibration of the hammer against the bell, and in this way producing the rattling noise peculiar to electric bells. Of course, when there is no pressure on the push-button no current reaches the bell, therefore there is no ringing, but so long as the push-button is kept closed the bell will vibrate. The course of the current throughout the circuit is indicated by the arrows.

ANSWERS TO INQUIRIES.

[*Note.—This column is open to any of our readers who desire special information on any subject. In case we cannot give the desired information ourselves the inquiry will be published, in order to elicit a reply from some one of our readers. These answers will be published in due course.*

The full names of our correspondents will not be published, but for the purpose of identification their initials or other mark of identity will be substituted therefor.

Each question will be numbered for the purpose of ready reference.

All are invited to make free and liberal use of this column.]

1.—Who is the original inventor of the dynamo? L. W. T., New York.

A. As far as known Pixii was the first to construct a dynamo electric machine. This was in 1833. The currents obtained were alternating. Saxton and Clarke are also among the earliest investigators. All dynamos are, however, based upon the discovery by Faraday, in 1831, of the laws of electro-magnetic induction.

2.—Does magnetism exert any physical effect upon a bar magnet? H., Troy, N. Y.

A.—Yes; the bar is slightly lengthened by the action of the magnetism. Experiments made by Joule showed that a bar increased in length $\frac{1}{720000}$ of its length when magnetized to its maximum.

3.—What is the cause of the peculiar odor around electric machines, coils and some dynamos? R. L. G., Brooklyn.

A.—You probably refer to the ozone that is produced. It is a modified form of oxygen gas, but is more chemically active and denser than oxygen. Ozone is a powerful bleaching and disinfecting agent.

4.—There is a way of rearranging the connections of a bell so that it will strike only once when the push-button is closed, instead of vibrating. Will you please tell how this is done and oblige? W. H., New York.

A.—Starting from the binding-posts on the bell, one wire runs to and around the magnets, then to the hammer-rod, or frame. The other binding-post is connected with the contact point of the bell. Now if you disconnect this wire from the contact point and connect it with the hammer rod, you will have a "single stroke" bell. You need not disturb the regular connections at the back of the bell. Just run an extra short piece of wire (insulated) from the binding-post last referred to to the hammer rod.

5.—In your article on Bells in last week's issue you advise using plenty of battery. I have found by experience that a large battery seems to cause heavy sparking at the contact points of the bell. What is the cause of that? R., Buffalo.

A.—You use too much battery. The sparking is caused by the self-induction of the magnets of the bell. Reduce your current but provide enough to operate the bell promptly and actively. There is a "just right" point that can be determined by a little experience.

6.—What substance is the best conductor of electricity? R. H. G.—Brooklyn.

A.—Annealed silver. All other resistances are compared with it.

Mr. Newton Harrison, instructor of the New York Class of the National School of Electricity, was presented with a handsome diamond scarf-pin by his class, on December 30, as a token of their appreciation of his ability and courtesy.

E. P. GLEASON MFG. CO.

The new catalogue of the E. P. Gleason Manufacturing Company, New York, reveals some interesting and useful novelties.

For advertising and other similar purposes the incandescent reflecting letters, of which the accompanying illustration of the letter G (Fig. 1) is an example, have many excellent points.

The effect produced by this style of letter is much greater than that from any other style of letter, and only one-half

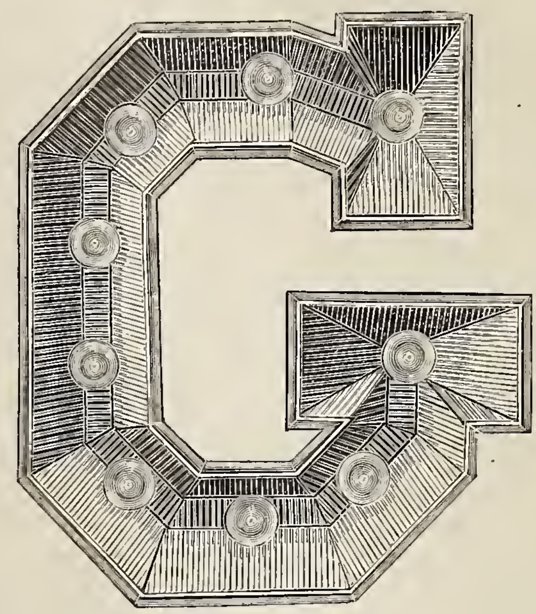


FIG. 1.

the number of lamps is required to produce this result. The saving in current and cost of lamps is therefore one-half.

These letters are made of metal and lined with silvered, corrugated glass, which gives a great many reflecting surfaces. The letters are thirty inches high and are fitted for Edison lamps.

The insulating joint (Fig. 2) has been approved by all the Boards of Fire Underwriters and is very extensively used in electric installations. The metallic parts are made

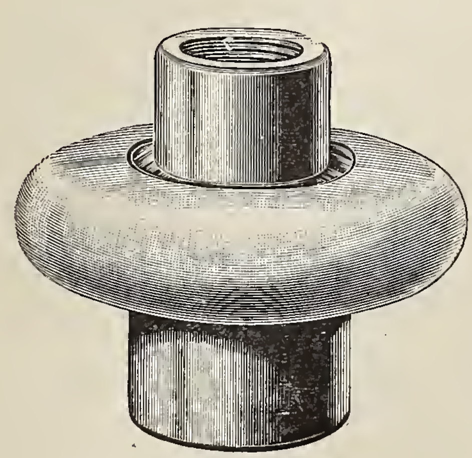


FIG. 2.

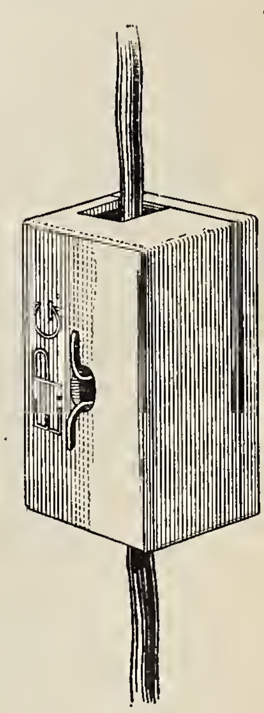


FIG. 3.

of composition brass, mica insulation being used. This joint is designed for combination fixtures, and is armored, the upper nipple being insulated from the lower one.

The Safety-Bug Cut-Out (Fig. 3) is the smallest covered bug made. It has a porcelain cover, and is a reliable little device,

The Gleason catalogue is very complete, and contains illustrations of a great variety of electrical appliances.

PRACTICAL EXPERIENCE WITH STORAGE BATTERIES IN CENTRAL STATIONS.*

BY C. L. EDGAR.

To those interested in selling electricity it is a source of great satisfaction that the storage-battery discussion has, within the past few months, especially in America, taken on an entirely new phase. It has become a question of use and not of manufacture.

For years we have all watched with great interest the various types of batteries put upon the market. We have discussed their value, at first confining ourselves as to whether they would work at all, and in later years broadening out the discussion as to how well they would work. We have watched the various companies interested in the manufacture of storage batteries fight one another in the courts, and we have wondered if it were ever to be possible to obtain a battery which did not infringe some one else's patent.

Until very recently it has not been possible to discuss from the standpoint of experience the economic merits of storage batteries, and it is particularly satisfactory to us to note that the discussion seems to have drifted away from the manufacturer to the user. To-night I am going to assume, at least for the purpose of this communication, that these perplexing questions have all been answered, and that we are finally on a par with our neighbors across the water, prepared to discuss the advantages of a commercial storage battery found ready to our hand.

Whatever may be the facts as to the existence of a commercial battery, some of us have purchased and are operating batteries which we consider satisfactory, and I will leave that part of the discussion to others, confining myself exclusively to their uses in an Edison system of circulation and distribution for lighting and power purposes in thickly settled communities. As it appears to me, their uses can be classed under four great heads, as follows:

1st. To carry the peak of the load at maximum hours.
2nd. To carry the entire load at minimum hours.
3rd. To act as an equalizer or reservoir.
4th. For the equipment of annex stations.

There are many other special uses for batteries which can be classed under one of these heads.

First, to carry the peak of the load. In all systems of lighting, whether by gas or by electricity, there is a considerable portion of the connected load which is used only for two hours per day during the three or four months in winter. We have all of us, at various times, very earnestly discussed the probability of being able to widen out this peak, as it is commonly known, and numerous schemes have been devised by which it has been made more or less of a hardship for customers to use their light at this time, special concessions being made at all other hours of the day or night. It does not seem to me that any of these will avail. We cannot get around the fact that there are, in every large city, hundreds of stores which close up at six o'clock at night. The only need which they have for light is after it becomes dark. In this section of the country darkness comes on about 4:30 in mid-winter, and these stores are bound to burn their light from 4.30 to six o'clock, and have no need of it at any other time. These are facts which are entirely outside of the question of electric lighting, and nothing which we can do will change them.

It matters not whether the company has a large motor load in the daytime or a large city contract at night. These are simply going to change the height of the curve at those hours. They are not going to alter the special shape of the curve due to the hour and a half of darkness during the business day.

This particular peak will be in some cases a much larger percentage of the total maximum output of the station than in others, but I think it is safe to assume that it is likely to vary only between one-third and one-half of the total. In the case of the company with which I am connected, we have found that if we divide our maximum load of the year into two parts, the upper half exists only for about two hours under ordinary circumstances and four hours under exceptional circumstances for the five winter months.

Computing the kilowatts in these two halves, we find that the lower half contains 90 per cent. of the K. W. hours manufactured, whereas the upper half contains only about 10 per cent. This would prove the position taken by some engineers that if an extremely large station was to be constructed, it would probably pay to equip it with two types of apparatus—50 per cent. to be of the best economy and most expensive class known to the art. This to do the 90 per cent. of the work. The other 50 per cent. to consist of crude, cheap, uneconomic but reliable apparatus, to do the 10 per cent. of the work. The saving in interest on the lesser investment in the second class would be much greater than the extra cost of running this half, due to its poor economy.

In our particular case we find ourselves in precisely this position. Our company installed in years past about 4,000 H. P. of high speed, belted, bipolar apparatus, reliable but of poor economy. Some three years ago it changed to the other extreme and commenced to equip with the highest priced and most economical apparatus to be found in the market, and today there is about 4,000 H. P. of this apparatus in use.

The data which we have for 1894 and 1895 proves the statement which I have just made. Ninety per cent. of our kilowatts have been manufactured by the vertical, triple expansion, multipolar units, and yet the total capacity of this apparatus is not over 50 per cent. of our maximum output for the winter.

The application of the storage battery to these conditions is obvious. What we need and what all companies under generally like circumstances need, is a piece of apparatus capable of doing two hours' work per day which is cheap, and which has fair economy. If storage batteries could be used under no other circumstances than these, it is, perhaps, somewhat doubtful whether it would pay to install them, but yet I am inclined to think that considering their first cost and the efficiency which we can obtain from them, it could be fairly proved that it would pay to use them rather than what I have designated as the cheap type of apparatus.

At the time our first battery was purchased, our standard unit was 650 H. P. We therefore called for a battery of 650 H. P. capacity for two hours. We eventually, under stress of circumstances, reduced this to one and a half hours, and found that it cost considerably less than a first-class steam plant.

As all apparatus has to be installed for the express purpose of taking care of the maximum load, it seemed to us very clear that if we could save in our first investment by installing storage batteries which cost less than a steam plant, we were going to be able to do a given amount of work with a less amount of capital by this means than by any other. We thus decided to install a battery to take care of the peak, even it we obtained no other advantage from it.

Second, to carry the entire load at minimum hours—I think that the nature of the load curve in America is against the use of batteries for this purpose to anything like the same extent as abroad. With us there is only about six hours of minimum load, whereas, owing to the lack of motor business in Europe, the minimum there extends some days from midnight until three o'clock in the afternoon. Our minimum is so short that we are not able to save one shift of men nor are we able to save much in the fixed boiler room expenses from drawing the fires, banking the boilers, or any of the various other expedients used when the plant is not in operation.

(To be Continued.)

* Topical communication presented to the Meeting of the American Institute of Electrical Engineers, New York and Chicago, November 20, 1895.

—Magnetism in iron and steel is quickly destroyed by heat.

DEATH OF COL. THOMAS W. KNOX.

Thomas W. Knox, the well-known author, died in New York on January 6, of Bright's disease. He was 65 years of age.

Col. Knox was a member of the expedition sent out many years ago by an American Company to build an overland telegraph line through Siberia. During this journey he travelled 3600 miles in sledges and 1400 in wagons, and in 1870 he described the trip in a book entitled "Overland Through Asia." In 1875 he went to Ireland and telegraphed to America the score of the international rifle match at Dollymount by means of an invention of his own, indicating by the use of the Morse code the spot in which each bullet struck the target. This he developed into a system of topographical telegraphy, which he sold to the Government for the transmission of weather maps.

TELEPHONES ON BROOKLYN BRIDGE CARS.

The Brooklyn Bridge officials experimented a few days ago with a telephone system connecting a moving train and the office of Train Despatcher Prince at the Brooklyn end of the structure. A conversation was carried on all the way over, and the train was stopped within fourteen seconds after Mr. Prince had ordered a danger signal hoisted. Superintendent Martin was favorably impressed with the results.

COPPER TELEGRAPH WIRES.

The Western Union Telegraph Company during the year ending June, 1895, added over 10,000 miles of copper wire to its extensive plant. The total wire mileage added was 11,859. The company has adopted the policy of replacing all defective iron wires with copper, the intention being to use that metal alone on all the principal lines hereafter. The advantages of saving in weight, increased capacity for electrical transmission and diminished liability to interruption from atmospheric conditions, are sufficient to make the copper wires more economical in the end, notwithstanding their greater first cost. The decision has been assisted, also, by the fact that the improvements in processes for drawing copper wire has enabled makers to furnish material well adapted for telegraphic use. The size of copper used for telegraph wires is generally No. 9 or 10 B. and S., weighing about 199 lbs. to the mile. This would require, for 10,000 miles, about 760 long tons of copper.

IMPROVED ELECTRIC SIGNAL FOR RAILROADS.

Mr. E. B. Dunn, chief of the Weather Bureau in New York City, has devised a system of electric signals for the purpose of preventing rear-end collisions on railroads. The idea suggested itself to him after the recent collision on the Brooklyn Bridge, and the plan has been submitted to the Bridge Trustees. We understand that they regard it with much favor.

Mr. Dunn's system is described as follows: A railroad is divided into sections, the length of the sections being determined by the conditions of emergency, liability to danger, etc. A series of wires, or a wire cable containing the necessary number of wires, is run along the telegraph poles and connected with the dispatcher's office. A box containing a switch and push-buttons is placed on each, or as many poles as may be found necessary, the apparatus to be used as follows: In case of a stop from any cause, or an accident, or when for any reason a train cannot leave on schedule time, a trainman goes to the nearest telegraph pole box, turns the switch, which lights up a line of red signal lights (also placed upon the poles) over the rear section, thus notifying the train following that the track ahead is not clear. A trainman of the second train repeats the operation on his section, which sets the signals on the section back of him, and thus the third train would be brought to a stop; the fourth, fifth and succeeding trains being notified and stopped in the same manner.

As soon as the first train is ready to resume its journey the trainman turns the switch back to its original position, and in so doing extinguishes the lights back of him, which indicates to the train behind that the road is again clear. All of the other section lights are extinguished in the same way and then the entire road is clear.

In connection with the turning of the switch to set the signal lights there is a wire running to the train dispatcher's office. By pressing a button in the pole signal boxes an indicator drop in the dispatcher's office notifies him that the train on section 1, 2, 3, etc., as the case may be, has been brought to a stop, and by pressing a second button in the same box a red light is shown in the dispatcher's office indicating that an accident has occurred—the red light being used for such emergencies only.

MR. STERNE'S TELEPHONE.

The temporary injunction which Simon Sterne obtained a year ago preventing the Metropolitan Telephone and Telegraph Company from removing the telephone from his office at 56 Beaver street has been made permanent by Justice Ingraham, of the Supreme Court, pending the action brought by Sterne for the same relief. He is required to give a bond to secure the company from loss of rents and damage, if it should ultimately be decided in the action that he was not entitled to the injunction.

The case is a test case, and mainly turned on whether the company has the right to fix rates arbitrarily, or whether it is a common carrier which must take business at such rates as the courts, in the absence of legislative direction, shall hold to be reasonable. Until October, 1894, Sterne had a telephone service at $125 a year, but in that month he and other subscribers were notified that owing to improvements in the service they must call and make new contracts for $240 a year. The company was to put in certain new improvements, notably the button arrangement, which was to cut off metallic induction. It was urged that the underground wiring had cost the company $3,000,000, and that it had resulted in better service. The company contended that its new rates were reasonable, and that in any event the courts could not say what it should charge its own customers, as it was a matter of private contract.

Mr. Sterne disregarded the threats of the company to remove his old telephone unless he signed a contract for the higher rates. He said that his old telephone was good enough for him. When the company finally set a day for him to sign or have the telephone removed he procured the temporary injunction from Justice O'Brien. Owing to the importance of the case it was argued very fully last February, and Justice Ingraham had since then reserved decision, having to wait a large part of the time for briefs of the counsel.

THE USE OF STORAGE BATTERIES IN ELECTRIC LIGHTING.*

BY DR. FRANCIS B. CROCKER.

(*Concluded from Page* 9.)

4. *Accumulators to aid in carrying the maximum load.*—If accumulators are substituted for a certain portion of the dynamo capacity, the question arises whether the substitution secures any advantage. In regard to first cost, authorities differ widely. These discrepancies probably arise from the confusion between K. W. and K. W. hour of output. Most accumulators have a normal time of discharge of about 10 hours, hence the cost per K. W. hour is only one-tenth of the cost per K. W. of output, and this would, of course, vary with any change in the time of discharge. In many cases it is specious and leads to mistakes to speak of K. W. hours, to appreciate which fact we have only to realize that the K. W. hour capacity of a dynamo is almost infinite, since it might run for twenty years. The actual

K.W. of output, or in short, how many lamps can be simultaneously fed, is the question in electric lighting. Moreover, in most cases, the time of discharge of an accumulator is unnecessarily long, and this is particularly true when it is used to help carry the heavy load, which usually lasts only one or two hours. In this case the remaining hours of available discharge are of little or no use. If it be attempted to discharge more rapidly, both the capacity and efficiency are reduced, and in many types the condition and very life of the battery are injuriously affected by a high rate of discharge. What is needed for the maximum load or "peak of the load diagram" is an accumulator with a normal time of discharge of two or three hours and having a correspondingly smaller first cost, bulk and weight, that is, about one-quarter of those of the ordinary forms of battery, but certain types of cell are capable of discharging at this rate. It is evident that the time of charging need not be made as short as that of discharging, if it happens to be more convenient to charge less rapidly.

The use of accumulators to enable the machinery to be stopped, which is a case already discussed, usually demands a time of discharge of from 10 to 14 hours, which agrees quite well with the normal discharge rate of the ordinary forms of battery, but even then the time is unnecessarily long, since the average rate of discharge would rarely exceed one-half of the maximum rate. Consequently the battery would either be incompletely discharged or the rate would have to be made excessive at certain times.

5. *Accumulators to maintain uniform load on the engines.*—Steam engines are very inefficient at light loads. This inefficiency, in fact, is one of the chief sources of loss in an electric lighting plant, and the principal object of the engineer who designs and operates a station should be to reduce this waste to a minimum. The accumulator is the most important means of accomplishing this result, although there are other methods, such as gas, thermal (hot water) and steam storage, all of which have been carefully compared by Mr. Nelson W. Perry, in a paper before the National Electric Light Association, February, 1895, "Storage of Energy Essential to Economy of Working Central Stations." Judicious selection of the number and sizes of the engines would enable them to be worked at a considerable fraction of their full capacity nearly all of the time, and it would seem that the same care that would be required to manage the battery might enable this to be accomplished. Nevertheless the accumulator gives more flexibility to the plant, and where introduced it often seems to considerably increase the economy of the engines by making their load more uniform and nearer their full capacity. According to the figures given by Mr. Perry in the paper cited above, an electrical horse-power costs $48.68 per annum when developed steadily, and costs $117.78 per annum with a variable load similar to that of an electric light station, that is, the latter costs about 2.4 times as much as the former. This ratio seems very high, but is borne out by statistics, which give a very large coal consumption for most electric light stations.

Under these circumstances, almost any method of making the engine loads more uniform should increase the economy of working. Doubtless an accumulator would benefit any plant in which an engine runs for any considerable portion of the time at less than half of its full power.

If a plant is so small that it contains only one engine, it may be necessary to run it a great deal of the time far below its full load. But even with two engines it is generally possible to select the sizes so that the smaller one runs economically during the periods of light load, the larger one alone is suited to medium loads, and both are used for the maximum output, the times during which any engine is very much underloaded being very short. With a greater number of units it becomes still easier to properly apportion the load, and when there are five or more engines, as is usually the case in large stations, the loss from this cause should be trifling. To be sure the waste of energy which occurs from using boilers for variable loads still remains, but according to the figures given by Mr. Perry this is less than that due to the engines, and general experience shows this to be true.

6. *Accumulators used as transformers.*—If the cells of a battery are arranged in series while being charged, and in parallel for discharging, a high-voltage current will be required for charging and a low-voltage cnrrent will be given out. The total amount of energy measured in watts is the same, minus the loss of 15 or 20 per cent. which always occurs in accumulators. The result is similar to that obtained by an alternating current transformer or motor dynamo. Such a method of transformation of potential might be employed in connection with long distance transmission of energy, the current being sent over the line at high voltage and converted to low voltage by accumulators for local distribution. For potentials of several thousand volts, which are commonly employed in transmitting long distances, the number of cells required would be so great as to make this of doubtful practicability compared with the ordinary stationary or rotary transformers, but it would give uniformity in load and other advantages which may be secured by the storage of energy.

7. *Accumlators used for subdividing voltage.*—This application is similar in principle to the preceding. The most important practical case is that in which a dynamo of 220 volts charges a battery of corresponding potential, a three-wire system being supplied from the battery, the neutral wire of which is connected to the middle point of the battery. This arrangement avoids the necessity of running two dynamos and allows the battery to be placed in a substation near the districts to be supplied, so that it is only necessary to run two conductors to that point instead of three. The same principle may be applied to the five-wire system.

8. *Accumulator sub-stations.*—The plan of installing battery plants at local centres which are charged from the main station, enables some of the conductors to be saved in a three or five-wire system, as already stated. It also makes it possible to reduce the size of these conductors, because the current which flows over them can be kept practically constant, so that it is not necessary to have them large enough to carry the maximum current consumed by the lamps, which may be several tines the average value. This, of course, gives the same steady load on the generating machinery as if the battery were located near it.

The batteries at the various sub-stations may be connected and charged in series or in parallel. The former plan is similar to case 6, and would require far less copper in the conductors, since the voltage is multiplied by the number of batteries in series and the current is the same as for a single battery. On the other hand, this high difference of potential would exist between the first and the last batteries of the series, and if either of them became grounded, any person connected to the earth and touching a wire supplied by the other battery would receive a shock due to the total voltage. This would demand that the maximum difference of potential should not exceed 500 volts, or, in other words, four batteries of 110 to 125 volts each might be charged in series and could be connected to the lamp circuits at the same time. This would practically amount to a five-wire system using accumulators to subdivide the potential, as explained in case 7. If the batteries were entirely disconnected from the lamp circuits while being charged, the latter would be free from danger of the high pressure, which might therefore be 1,000 or 2,000 volts if desired, the batteries being charged during the day and supplying the lamps at night. For continuous working, two batteries would be necessary. Accumulator sub-stations not only save copper in the feeders but also reduce the cost of, and lost voltage in the distributing conductors, because the batteries can be placed near the lamps to be supplied with current.

9. *Accumulators used for two or more of the above-named purposes.*—Each of the different uses of the storage battery has been considered separately to avoid the confusion with which this subject is often beset, but as a matter of fact the employment of the accumulator for several of these purposes is the most common practice. By thus combining these different applications the plant may be

rendered not only more economical but also much more flexible. For example, the battery may be utilized to help out the generating machinery at times of heavy load or when the latter is partially or wholly disabled. It often happens that it is difficult to produce or maintain sufficient steam pressure, owing to poor draught or other circumstances, in which event a battery enables the boilers to be temporarlly relieved of some or all of the drain upon them while the pressure is being raised to the proper point. It may also be necessary or desirable to shut down the machinery, or a portion of it, for a few minutes to make some repair, adjustment or change of arrangement, connection, etc.

It is also possible to feed some of the circuits from the battery, while the others may be supplied at a higher or lower voltage by the machinery. In these and many other ways an accumulator may be a very convenient adjunct to an electric-lighting system. The fact that it is so radically different from the machinery in its nature and action makes it very unlikely that the entire plant will be crippled at any one time, since the two sources of current are not exposed to the same dangers. An accident to the steam-piping, for instance, might shut down all the machinery, but it probably would not affect the battery, and *vice versa* an accident to the latter is not likely to extend to the former.

LEASE RATIFIED.

The lease of the Eighth avenue street-railway to the Metropolitan Traction Company, New York, has been ratified. It is for 99 years from January 1, 1896, at an annual rental of $215,000 in gold, payable quarterly. The lessees also agree to expend $1,000,000 in substituting other motive power than horses and in improving the equipment. In regard to the change of motive power Mr. H. H. Vreeland said :

"Our series of experiments on the Lenox avenue road are finished so far as the electricity is concerned. We know now exactly what we can do with the underground trolley. But we are looking forward to some mechanical changes in the conduits and the slots, as we do not know exactly what effect cold weather will have on our roadway. This we expect to find out this winter. In the early spring we shall push forward the construction of the 23d street underground trolley, which is now partly constructed, and embody in that all the improvements suggested by our experience in Lenox avenue this winter. Next, we shall put the underground trolley in Sixth avenue, and I may say that the plans for that work are practically complete. After that we shall go to work on Eighth avenue."

THE AMERICAN ELECTRICAL WORKS.

The *Evening Telegram*, Providence, R. I., on December 21, 1895, issued a beautifully illustrated number, giving a history of industrial Providence. Among the large interests described the American Electrical Works is given prominence. The Phillipsdale Works are excellently illustrated, and the various plants occupied by the company at different periods are also shown. The features of Messrs. Phillips, Sawyer, Hathaway and Remington are reproduced very nicely.

THE TECHNICAL JOURNAL.

The first number of *The Technical Journal*, New York, made its appearance last week. This new paper is to be published bi-monthly at 248 East 78th street, New York. Mr. Max Loewenthal is the editor; Meyer Cushner, associate editor, and Meyer S. Blumberg, business manager. *The Technical Journal* has been adopted as the official organ of "The Alumni Association of the Hebrew Technical Institute," and the principal object of its existence is the diffusion of general culture in art and science.

A. S. R. A.—We have received a copy of the minutes of the 14th annual meeting of the American Street-Railway Association, which was held in Montreal last October.

New York Notes.

Mr. Frederick Pearce, 79 John street, has obtained possession of the entire building at that number and is establishing his office and salesrooms one floor lower down. He is putting in new show-cases and other fixtures, and when his plans have been completed he will have one of the finest establishments in the country.

W. P. Freeman has moved to 106 and 108 Liberty street, city, where he has placed a line of fine machinery for experimental work.

The Barriett Armature Winding Co., 78 and 80 Cortlandt street, city, makes a specialty of winding armatures of all makes and sizes. The company is doing a good business in this line.

Possible Contracts.

LEXINGTON, KY.—The erection of an electric light plant is being considered by the city. Address the mayor.

BALTIMORE, MD.—The Edison Electric Illuminating Co. will enlarge the plant of the former Maryland Electric Co., and will also erect another plant of the same capacity.

WASHINGTON, D. C.—A building permit was taken out by Mr. F. L. Loring, of New York, for the erection of a store and office building at 1327 F Street, Northwest, to cost $25,000.

CANANDAIGUA, N. Y.—Canandaigua people are moving for a new opera house with a seating capacity of 1,000, to cost about $15,000.

NEW YORK CITY.—George H. Anderson will erect a seven-story brick office building at 508 Broome Street. Architect, A. F. Leicht, 97 Cedar Street.

NEW YORK CITY.—J. B. McElfatrick, 1402 Broadway, has prepared plans for a five-story brick theatre building to be erected at Lexington Avenue and 42d Street, for Robert and Ogden Goelet. Estimated cost, $170,000.

DETROIT, MICH.—Plans and specifications are being prepared for the erection of a $75,000 armory by the Detroit Light Board.

GREENVILLE, N. C.—The Greenville Electric Light Co., of which S. C. Hamilton, jr., is manager, is in the market for an electric light plant of 35 arc and 400 incandescent lights.

ALBANY, N. Y.—The granting of the franchise for the electric road to Greenbush has been postponed for at least two weeks, when applications will again be advertised.

CHARLESTON, W. VA.—The Charleston Street Railway will erect an electric power plant.

NEW YORK CITY.—The Bohemian Benevolent Literary Association is to have a new club-house on 73d street, near First avenue. The building will have five stories and will cost about $125,000. Plans were prepared by Architect William C. Frohne.

UNION, S. C.—The mayor can give information concerning the issuance of $40,000 worth of bonds to be used in erection of electric light plant.

KANSAS CITY, MO.—A five-story building, to cost $60,000 or more, will be erected by J. C. Rogers, of Wamego, Kan. He contemplates putting in an electric light plant, etc.

St. Louis, Mo.—An electric power plant will be erected by the Central Railway Company. Address Wm. S. Long.

Prosperity, S. C.—The Prosperity Cotton Mill Co. wants bids for an 80-arc-light electric plant, boilers, engines, etc.

Somerville, Tenn.—A. J. Rooks is in the market for storage batteries to light up a good-sized building with electricity.

Brooklyn, N. Y.—The old Smith Mansion, on Smith Street, now occupied by the New York and New Jersey Telephone Co., is to give place to a new structure, to cost in the neighborhood of $150,000, and will be eight stories in height.

New York City.—F. Nordselk will erect an eight or ten-story office building, to cost $350,000, on the south side of Rector Street. Architect Wm. B. Tuthill, 287 Fourth Avenue, prepared the plans.

Columbus, Ga.—About $50,000 will be expended by the Columbus Railroad Company to enlarge its plant.

Dublin, Ga.—An election will be held January 12 for an electric light plant and water-works. $25,000 worth of bonds proposed. Address the mayor.

Baltimore, Md.—The construction of conduit systems for underground wires is being contemplated by the city. W. S. Hill, Jr., is engineer of the subway commission. Address Alcæus Hooper, mayor.

Philadelphia, Pa.—Vandergrift & Jacobs, 1404 S. Penn square, will probably buy seven enclosed motor cars with double equipment for the trolley they are building in Charleston, W. Va.

Alexandria, La.—Bids will soon be advertised by the city for a 50-K.W. alternating dynamo, etc. Address A. C. Jones, superintendent electric light plant.

Gainesville, Fla.—New or second-hand plant of 40 2000-c. p. arc and 1000 16-c. p. incandescent lights is wanted by Gainesville Electric Co., Box C.

New York City.—D. Altman & Company, dry goods firm at Sixth avenue and 19th street, have decided to enlarge their establishment. They will also erect a large stable.

Erie, Pa.—Plans have been drawn for the erection of a six-story brick block at the northeast corner of 12th and State streets. The new building will be used for offices and stores, and owned by the Erie City Iron Works.

Frederick Potter and C. H. Kalsey, executors of the estate of Orlando B. Potter, have filed plans for a new building to be erected on the site of Arcade Building, corner of Rector street and Broadway. The new building will be 20-stories high and will cost $1,000,000.

St. Louis, Mo.—Henry Moser, C. H. Hofmeister, D. P. Shields and Jesse A. Graham have incorporated the National Automatic Car Fender Co. Capital stock, $125,000.

Richmond, Va,—Work has been begun by the Richmond Traction Company on its electric line on Broad street. J. Skelton Williams, president.

Jackson, Tenn.—Arrangements are being made by the Jackson Street-Railway Company to reconstruct its trolley line.

Washington, D. C.—The Columbia Railway Company has asked permission to extend its lines in the city.

Charleston, S. C.—A franchise has been asked for to build an electric line in the city, by Julian Fishburne and others.

Charleston, S. C.—The Carolina Mutual Telephone and Telegraph Company has been chartered with E. M. Bailey president, Moultrie Mordecai, vice-president, and R. B. Letby, secretary and treasurer. Capital stock, $30,000.

Central City, Ia.—The Bishop Telephone Exchange is a new corporation at Central City. The object of the corporation is to build and operate telephones. The first line to be completed is from Central City to Prairieburg. It is probable lines will connect Central City with Coggon, Paris and Troy Mills. Authorized capital, $30,000. President, P. G. Henderson; secretary, J. H. Davis; treasurer, I. U. Ninehart.

Knoxville, Tenn.—A line will be constructed from Chattanooga to Maryville by the People's Telephone Company.

Delphi, Ind.—A franchise has been granted the Harrison Telephone Company by Delphi, to put in an exchange in that city.

New York City.—The home of the New York Historical Society is to be deserted for a spacious and magnificent new building on Central Park, West, with a frontage of an entire block overlooking Central Park, from 76th to 77th streets. Estimated cost of the building, $450,000. President, John Alsop King, of the society.

Quebec, Que.—The Quebec and Montmorency Electric Power Company are considering a proposal to light public buildings in Lewis, and to convey the electric current across the St. Lawrence for the purpose by means of a cable laid at the bottom of the river.

New Corporations.

Sheffield, Ala.—The Consolidated Water and Electric Light Power Co. has been organized by E. F. Enslen, C. B. Ashe, L A. May, F. V. Evans and W. R. Brown. E. F. Enslen, of Birmingham, president, and C. B. Ashe, of Sheffield, secretary and treasurer. Capital stock, $250,000.

Portland, Me.—The Boston Electric Insulated Pole Co. has been organized for the purpose of manufacturing, doing business in and erecting insulated poles upon which wires may be strung. Capital, $100,000. President, Edward E. Drew, of Boston, Mass.; treasurer, George E. Macgowan, of Portland.

Bloomfield, N. J.—The O'Brien Electrical Construction Co. Capital, $100,000. Incorporators, Philip J. and James P. O'Brien of New York, and Daniel J. O'Keefe of Bloomfield.

Cleveland, O.—Cleveland and Chagrin Falls Electric Railroad is authorized to build, equip and operate an electric railroad for the transportation of passengers, freight, mail and express between Cleveland and Chagrin Falls; to furnish heat, light and power and to own and operate pleasure resorts. Capital stock, $300,000. Incorporators, Hon. Vincent A. Taylor, F. W. Gehring, Jay E. Latimer, Hon. Joseph Black, C. G. Barkwill and Albert V. Taylor.

Harrisburg, Pa.—The Latrobe and Ligonier Electric Street Railway Co. has been chartered. The road will be 12 miles in length, and the route will be from Loyalhanna Creek, through the township of Unity and the boroughs of Youngstown and Ligonier. Capital, $72,000. Edward E. Robbins, of Greensburg, is president of the company.

Baltimore, Md.—The Rapid Transit Construction Co. has been incorporated by Wm. F. Rogers, Chas. H. Hopkins, Wm. C. Nelson, Harry C. Primrose and George N. Holloway, for the purpose of manufacturing, etc., in which electricity will be used. Capital stock, $25,000.

Baltimore, Md.—The Maryland Electric Co. and the International Telegraph District and Construction Co. have consolidated under the name of the Edison Electric Illuminating Co., with Alfred A. Glasier, president ; E. S. Webster, vice-president, and J. Frank Morrison, manager. Capital stock, $1,770,000.

Cherryfield, Me.—The articles of association of a new railroad have been filed with the railroad commissioners. The road will run from Cherryfield to Millbridge, five miles, and will be an electric one. Capital, $30,000. Directors, S. D. Leavitt, of Eastport; George A. Curran, and G. A. Murch, of Calais; G. R. Campbell, of Cherryfield, and James Mitchell, of Portland.

Rochester. N. Y.—The J. E. Putnam Co., to manufacture electrical appliances. Capital, $15,000. Directors, Sylvenus A. Ellis, Joseph F. Putnam and William R. Hale, of Rochester.

Albany, N. Y.—The Empire City Traction Company, to construct a street surface railroad in New York City three and a quarter miles in length. Capital, $100,000. Directors, Henry L. Scheurman, Frank P. Knight, Edgar M. Johnson, Franklin Defreece, Francis W. Elder, Mark J. Katze, Henry W. Marr, of New York City; Homer R. Scoville, of Brooklyn, and Samuel S. Slatter, of Arlington, N. J.

Millbrook, Ont.—Millbrook Electric Light Co , incorporated. Capital, $6,500. To carry on general lighting business.

Fraserville, Que.—Fraserville Electric Power Co., applying for incorporation. Capital, $25,000. To operate telephone lines, electric light plants, etc.

Chicago, Ill.—Rockford Traction Co. Capital, $300,000. To construct and operate street railways in Rockford. Incorporators, C. Harry Moore, Harry L. Jewell, Wm. Foster Burns and Harry L. Jewell, 115 Dearborn street.

Chicago, Ill.—Brainerd Traction, Light and Power Co. Capital, $300,000. To construct and operate street railways, water-works and electric lights. Incorporators, John Campbell, Edward S. Elliott, 1103 Home Insurance Building, and William Bruce.

Montreal Que.—Northern Electric and Manufacturing Co.; incorporated. Capital stock, $50,000. To manufacture brass, copper, etc.

NEW TELEPHONE COMPANIES.

Florence, Ala.—The Citizens' Telephone Company has been organized with W. P. Campbell, president; M. B. Shelton, vice-president; James Burtwell, treasurer; H. B. Lee, secretary.

Fort Valley, Ga.—The Fort Valley Telephone Company has been incorporated by W. H. Harris, B. S. Harris and W. P. Harwell, to construct telephone system. Capital stock, $5,000.

Cleveland, O.—The Home Telephone Co. has been incorporated. Capital, $50,000. Incorporators, Henry George, jr., Albert V. Taylor, C. W. Collister, Jay E. Latimer and Francis J. Wing.

Baltimore, Md.—The Southern States Telephone Co. has been incorporated by Augustus G. Davis, J. Austin Fink, and Wm. M. Winklemann, of Baltimore, and R. B. Hazlett and Charles E. Fink, of Carroll County. Capital stock, $100,000.

Harrisburg, Pa.—A charter has been granted at Harrisburg to the Citizens' Telephone Co., of Honesdale, with a capital of $5,100.

Telephone Notes.

Seneca, N. Y.—The telephone line at Seneca Falls will be extended through Seneca County south, touching Bearytown, Romulus, Willard, Ovid, Farmer Village and Trumansburg, thence to Ithaca.

Medina, O.—Medina citizens are considering the placing of a telephone system in town.

Flemingsburg, Ky.—A move is on foot to build a telephone line from Flemingsburg to Moorefield, by way of Crains, Hilltop, Sapp, Davidson and Sprout.

Centralia, Ill.—The Central Union Telephone Co. is making arrangements to extend the line from Nashville to Mascoutah.

Vinal Haven, Me.—The people of Vinal Haven are desirous of having a system of telegraph and telephone lines.

Beeville, Tex.—A company has been organized to construct a telephone line from Victoria to Tilden.

Bedford City, Va.—A telephone company has been formed by Charles R. Mosby.

TELEPHONE PATENTS ISSUED DECEMBER 31, 1895.

Electric Telephone. Stephen D. Field, Stockbridge, Mass. (No. 552,173.)

Double-Diaphragm Telephone-Transmitter. Daniel Drawbaugh, Eberly's Mill, Pa. (No. 552,469.)

TRADE NOTE.

H. Clayton Jones & Co., electrical engineers, 749 Washington street, New York, does electrical work in all its branches.

THE COLUMBIA CALENDAR.

The Pope Mfg. Co., Hartford, Conn., has issued its eleventh annual Desk-Pad Calendar for 1896. It is a very neat and handy calendar.

ELECTRICAL and STREET RAILWAY PATENTS

Issued December 31, 1895.

552,094. Automatic Electric Switch. Harry H. Blades, Detroit, Mich. Filed Sept. 14, 1895.

552,103. Multipolar Electromagnet. William P. Daniels, Cologne, Germany, assignor to the Siemens & Halske Electric Company of America, Chicago, Ill. Filed Sept. 7, 1895. Patented in Germany July 11, 1895, No. 82,855.

552,105. Apparatus for Automatically Maintaining Current upon Moving Vehicles. Harry E. Dey, assignor to Edward N. Dickerson and Ernest R. Esmond, New York, N. Y. Filed May 20, 1895.

552,162. Car-Fender. Robert Wilkinson, Philadelphia, Pa. Filed Sept. 6, 1895.

552,166. Electric Thermostat and Push-Button. Orator F. Woodward, Le Roy, New York. Filed Dec. 29, 1893.

552,172. Electromagnetic Mechanism. Stephen D. Field, Stockbridge, assignor to the American Bell Telephone Company, Boston, Mass. Filed Aug. 5, 1895.

552,173. Electric Telephone. Stephen D. Field, Stockbridge, assignor to the American Bell Telephone Company, Boston, Mass. Filed Aug. 5, 1895.

552,181. Electrical Railway Signaling Apparatus. Henry J. Hovey, Evanston, Ill. Filed Aug. 5, 1895.

552,190. Electric-Arc Light. Louis B. Marks, New York, N. Y., assignor to the Electric Arc Light Company, same place. Filed Oct. 9, 1894.

552,211. Depolarizer for Primary Batteries and Method of Making Same. Gustav W. Thurnauer, Aurora, and Milton M. Kohn, Chicago, assignors to themselves, and Siegfried M. Fischer, Chicago, Ill. Filed Feb 20, 1895.

552,218. Electric Battery. David S. Williams, Philadelphia, Pa. Filed July 19, 1895.

552,219. Electrical Battery. David S. Williams, Philadelphia, Pa. Filed Aug. 23, 1895.

552,220. Electric Battery. David S. Williams, Philadelphia, Pa. Aug. 23, 1895.

552,239. Safety Device for Electric Circuits. Paul H. D'Unger, Chicago, Ill., assignor of one-half to William Porter Verity, same place. Filed Sept. 16, 1895.

552,260. Apparatus for Transforming Alternating Currents into Unidirectional Currents. Carl Pollak, Frankfort-on-the-Main, Germany. Filed May 22, 1893. Patented in France Oct. 28, 1892, No. 225,265; in England Nov. 2, 1892, No. 19,729; in Switzerland May 26, 1893, No. 7,059; in Austria Apr. 3, 1894, No. 66,108, and in Hungary Apr. 3, 1894, No. 3,318.

552,270. Car-Fender. John H. Astruck, New York, N. Y. Filed May 1, 1895.

552,271. Electrical Bicycle. Ogden Bolton, Jr., Canton, Ohio. Filed Sept. 19, 1895.

552,279. Electric Signal for Railways. Elisha B. Cutten, New York, assignor to Arthur C. Fraser and George H. Fraser, Brooklyn, N. Y. Filed April 1, 1891.

552,281. Street-Car Fender. Frederick Fiechter, Philadelphia, Pa. Filed Jan. 23, 1895.

552,283. Car-Fender. Aaron Fryer, Bath-on-Hudson, N. Y. Filed May 19, 1895.

552,286. Street-Car Fender. John W. Harris, Columbus, Ohio. Filed October 7, 1895.

552,309. Electric Meter. John R. Tucker and Charles C. Hinckley, Aurora, Ill. Filed March 25, 1895.

552,312. Motor for Bicycles. Sumter B. Battey, N. Y., N. Y. Filed April 19, 1895.

552,313. Synchronous Single-Phase Motor. Charles E. L. Brown, Baden, Switzerland. Filed Feb. 6, 1893.

552,316. Electrical Railway Signaling System. Thomas B. Dixon, Henderson, Ky. Filed July 10, 1894.

552,322. Secondary Battery. Alvaro S. Krotz and Wilbur W. Spencer, Springfield, Ohio. Filed Jan. 31, 1895.

552,337. Electric Motor. Albert W. Smith, Washington, D. C. Filed July 23, 1895.

552,338. Electrical Rail-Fish. Victor Thélin, Geneva, Switzerland, assignor to the Compagnie de l'Industrie Électrique, same place. Filed Aug. 1, 1895.

552,341. Electric Smelting Furnace. Joseph A. Vincent and James E. Hewes, Philadelphia, Pa. Filed July 18, 1895.

552,347. Motor-Suspension for Street-Cars. George F. Card, Mansfield, Ohio. Filed Aug. 21, 1895.

552,349. Car-Fender. Samuel H. Coffee, Beverly, N. J. Filed May 17, 1885.

552,363. Insulating Joint. Elliott P. Gleason, Brooklyn, assignor to the E. P. Gleason Manufacturing Company, New York, N. Y. Filed Dec. 27, 1894.

552,369. Means for Operating Electric-Railway Vehicles. Ernst G. W. C. Hoffmann, Charlottenburg, Germany, assignor to the Siemens & Halske Electric Company of America, Chicago, Ill. Filed Sept. 3, 1895. Patented in Italy, Apr. 8, 1895, No. 38,405; in England, May 5, 1895, No. 6,007, and in France, June 20, 1895, No. 245,761.

552,371. Method of and Apparatus for Measuring Illumination. Edwin J. Houston and Arthur E. Kennelly, Philadelphia, Pa. Filed Feb. 13, 1895.

552,377. Car-Fender. Henry Kramer, Jr., New York, N. Y. Filed April 30, 1895.

552,384. Electric Gas-Lighter. Philip Meyer, Alameda, Cal. Filed Sept. 20, 1895.

552,397. Regulator for Dynamos. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed June 1, 1889.

552,425. Secondary Battery. Camille A. Faure, Paris, France, and Frank King, London, England. Filed March 6, 1895.

552,451. Electric Railway. Michael H. Smith, Halifax, England. Filed Oct. 26, 1887. Patented in England, Dec. 28, 1886, No. 17,018, and in Belgium, June 13, 1887, No. 77,792.

552,465. Burglar-Alarm Attachment for Railway-Cars. Jacob C. Bratton and Arthur B. Graham, St. Louis, Mo. Filed Aug. 19, 1895.

552,469. Double-Diaphragm Telephone-Transmitter. Daniel Drawbaugh, Eberly's Mill, assignor to G. Milton Bair, Hanover, and Calvin W. Ream, Reading, Pa. Filed Feb. 23, 1895.

552,475. Car-Fender. William T. Haugh, Waynesborough, Pa., assignor of three-fourths to John Philips and John M. Ripple, same place. Filed Aug. 21, 1895.

552,477. Rail-Bond for Electric Railways. Budd J. Jones, Chicago, Ill. Filed March 29, 1895.

552,479. Electrical Rail Bond. Minott K. Kendall, Melrose, assignor of two-thirds to Gilbert Hodges, Medford, and Ephriam Harrington, Boston, Mass. Filed Aug. 12, 1895.

552,495. Regulator for Electrical Circuits. Joseph C. Mayrhofer, New York, N. Y., assignor to Denman Thompson, West Swanzey, N. H. Filed July 5, 1895.

552,496. Electric-Lighting System. Joseph C. Mayrhofer, New York, N. Y., assignor to Denman Thompson, West Swanzey N. H. Filed July 5, 1895.

552,498. Electric-Arc Incandescent Lamp. John A. Mosher, Chicago, Ill. Filed Sept. 23, 1895.

552,501. Insulator. Charles H. Snively, Mount Carmel, Pa. Filed March 20, 1895.

ELECTRICAL AGE

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CONTENTS.

BAPTISM OF FIRE.

We wish to convey to our esteemed contemporary, the *Western Electrician*, our sympathy in its recent loss by fire of its composing material. With characteristic enterprise, however, a way was found out of the difficulty and the last week's issue was gotten out under enormous difficulties and very little behind time.

TELEPHONE CONTRACTS.

In the case of Henry C. Wisner, *vs.* the Michigan Bell Telephone Company, Judge Carpenter, in the Circuit Court at Detroit, has rendered a decision to the effect that the contract the telephone company requires its subscribers to sign is unreasonable. Wisner applied for a telephone, but would not sign the formal contract because it stipulated that no one but himself and his employés should use the instrument. This requirement, Judge Carpenter decides, is unreasonable.

PROTECTING VALUABLES.

The police department of this city has been taking a census of the safes and strong boxes in offices, stores, etc., throughout the city, for the purpose of affording better police protection. This step is a good one, but should be supplemented by the introduction of electric protective devices. The two classes of watchmen would then doubly insure the safety of valuables, and no burglar would make an attack upon a depository of valuables if he felt that the eye of the police and the sleepless electric eye were watching his movements.

TELEPHONE WAR IN BAYONNE.

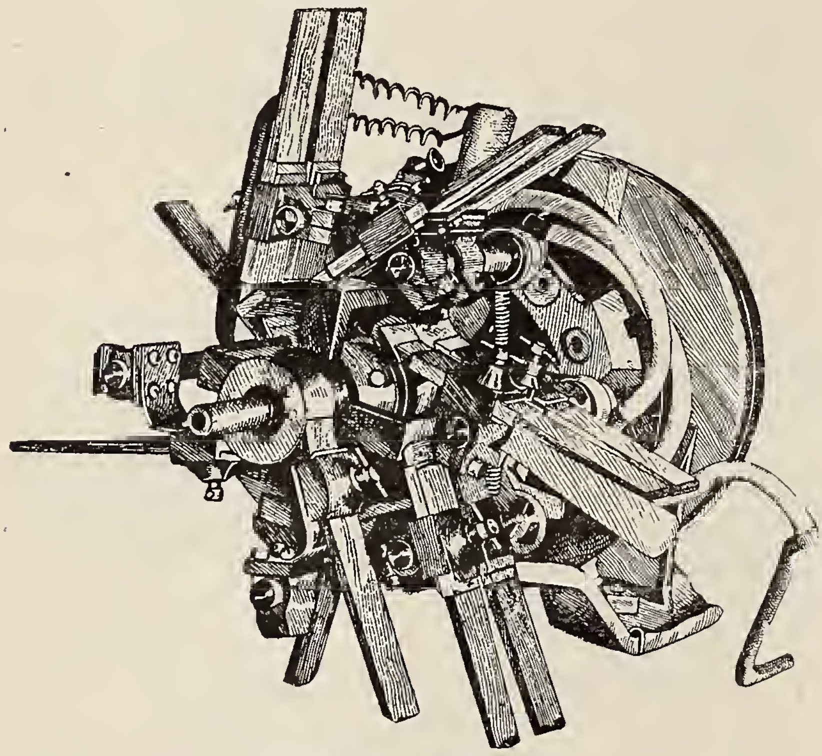
A small war exists in Bayonne, N. J., between property-owners and the New York and New Jersey Telephone Company, which for the time being completely overshadows interest in the future Venezuelan and South African scrimmages. The telephone company has erected some of its poles along certain streets, and the property-owners objected to having them there. A temporary suspension of hostilities was effected, but at the expiration of the armistice active warfare was resumed on the side of the property-owners, and pole-chopping has been resorted to. The property-owners seem to have the advantage just now and are making the best of it. The trouble is to be carried to the City Council next Tuesday evening, when, it is said, some lively times are expected.

OUR NEW DEPARTURE.

It is with much satisfaction that we note the encouragement and support we are receiving in our efforts to present to the rising generation of electricians, in simple language, the mysteries of electricity and its various applications. No other electrical journal does this, and that our efforts are appreciated is evident from the fact that our subscription list is rapidly increasing in size. We propose to cover the entire field of electric application, and we trust that those for whom the work is designed will receive the benefit from it that we hope they shall. As indicated at the head of the "Elementary Education Department" column, all of our readers are free to ask questions on any pertinent subject. We will gladly answer such inquiries through the "Answers to Inquiries" column, for their special benefit and for the benefit of the readers at large. In writing these articles we shall endeavor to cover every point as completely as possible, and state the facts involved as plainly as possible. One new subscriber, when asked how he liked the articles, replied "Fine; but I haven't seen the next paper yet." This was only two or three days after the last issue was out. Evidently this young man was impatient for more, and thought that a week between issues was too long an interval. That is the kind of support we like; it takes the dull edge off the labor connected with the production of the articles, and helps to make the work a pleasure.

A NEW ELECTRICAL-CURRENT RECTIFIER.

The advance sheets of the January number of Consular Reports, received from the State Department, Washington, contain an illustrated description, by Frank H. Mason, U. S. Consul-General at Frankfort, Germany, of a new Electrical Current Rectifier, which is attracting much attention among electrical engineers in that country. For the benefit of interested readers we reproduce Mr. Mason's report on the subject, and the illustrations accompanying the same.

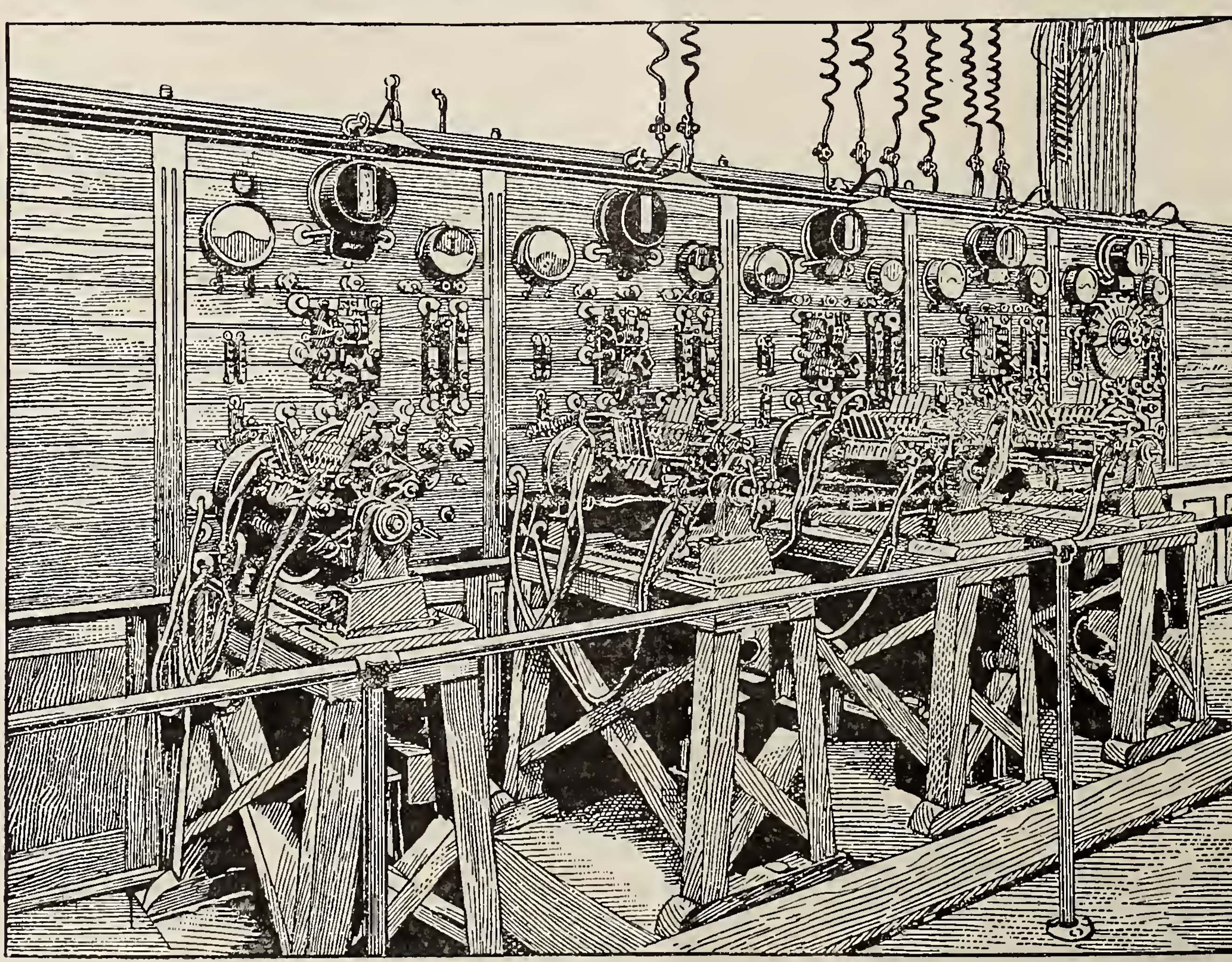


CURRENT RECTIFIER.

"The rapid extension of incandescent gas lighting during the past two years, its comparative cheapness and high degree of brilliancy, added to the now demonstrated possibility of changing its tint by varying the combination of oxides in the incandescent mantles, have combined to check somewhat the adoption of electric lighting in Germany, and to force electrical companies to seek new outlets for their energy in the directions of motive power and electrolysis. The central electrical system established at Frankfort a few months ago has proven technically successful, but private consumers generally complain of its high cost, and it is already evident that the financial success of the enterprise will depend in future upon the more general adoption of electricity for motive and electro-chemical purposes.

"These conditions have lent exceptional importance and interest to a device known as *Gleichrichter*, or rectifier, invented by Mr. C. Pollak, a Frankfort engineer, which solves the hitherto stubborn difficulty of converting an alternating into a direct electrical current with a loss of but a trifling percentage of its energy. In nearly all cases where the central generating station is located at any distance exceeding a mile from where the electrical energy is to be finally used, alternating currents are preferred as more available than continuous ones, for the reason that the former can be readily condensed to very high pressures and in that condition transmitted to any reasonable distance, and then reduced to low-working potential by stationary transformers. A continuous current, on the contrary, can be reduced only by the use of a working converter, running in synchronism with the central generator—an additional machine which greatly increases the cost of the plant. For this and other reasons alternating currents are usually produced at modern power stations in Germany, and while equally available for incandescent lighting and for motors which can be run synchronously with the dynamo, they are distinctly inferior for arc lighting, and can not be used at all for electrolysis or charging storage batteries.

"The invention herein described bridges, therefore, an industrial difficulty which has become more and more serious with each step of progress in transmitting electrical energy over long distances from the place of generation. Electricity is supplied at Frankfort from the municipal central station at 7¼ pfennigs (a little more than 1¾ cents) per unit, in the form of single-phase alternating currents of 3,000 volts. At the accumulator works, where the Pollak system has now been in successful operation for



CURRENT RECTIFIERS IN THE MUNICIPAL STATION, FRANKFORT, GERMANY.

more than a year, this current is reduced by transformers to 65 volts and then rectified—that is, converted into a direct current by the new device, which may be described briefly as follows :

"It is well known that every continuous-current generator produces to a greater or less extent alternating-current impulses, but in such machines this tendency is corrected by the commutator, which is fixed directly on the armature shaft and imparts to the entire current a uniform direction. The problem was, therefore, to devise a plan by which a commutator, located at any distance from the dynamo creating alternating currents, and turning synchronously therewith, should have the same effect of turning the entire current in a uniform direction—in other words, converting the alternating currents after they have passed into the outer circuit into a direct one. For this purpose the present invention employs two collector rings and two rows of commutator bars, the latter insulated from each other and the shaft and alternately connected with the rings. The alternating currents, having been received from the central station and reduced to 65 volts, as above stated, enter the machine through brushes resting on the rings. The direct current is taken off by four more rows of brushes arranged adjustably, the first and third and the second and fourth rows being connected with each other.

"The rectifier is turned by a synchronous motor of small dimensions, which receives its alternating currents, likewise reduced to 65 volts, from a small special transformer provided for that purpose. The outer circuit of the continuous current which passes from the rectifier includes an automatic disconnecter, fluid-resistance ampèremeter, and, in various parallel shunts, electric motors and cells with their voltmeters and other apparatus. The converted current produced by the rectifier is not entirely continuous, but pulsating, the length of the pulsations being governed by the width of the commutator bars and the speed of the central generator. The duration of contact can be regulated by adjustment of the brushes, and this adjustment should be so made that the motive force of the current shall not fall below that of the battery, which would otherwise charge back into the circuit.

"Four of these rectifiers, each for 350 ampères, have been in continuous service day and night at the works of the company in Frankfort for more than a year, with such complete success that the system may be fairly claimed to have passed the experimental stage. Their efficiency is stated to be 96 per cent.—that is, the alternating currents are converted into direct ones with a net loss—including the slight reaction of about two per cent. on the transformer—of only four per cent.

"As every experienced electrician will readily infer, the direct pulsating current thus created is admirably adapted for electrolytical work, it being an established principle that the induced currents resulting from such pulsations greatly promote electrolytical action. It also lights arc and incandescent burners, runs continuous-current motors of all sizes down to the smallest, and is used for charging storage batteries, which is the chief function of the Frankfort company. The rectifier and its accessories are exceedingly compact, the whole installation, including seven transformers, occupying only 25 square yards of space, within which compass the apparatus and its capacity might easily be doubled should occasion require. The rectifiers are small, require no other foundation than wooden trestles resting on a solid factory floor, and demand no more oversight than an ordinary dynamo. From the testimony of the inventor and the numerous experts who have visited Frankfort specially to examine the system, the current supplied by the new rectifier is for all practical purposes identical in value and effects with the continuous currents hitherto produced in the ordinary manner."

PERSONAL.

Mr. Cecil, electrician of the *New York Herald*, recently met with a severe accident, and is now in the New York Hospital. He hopes to be around again before long.

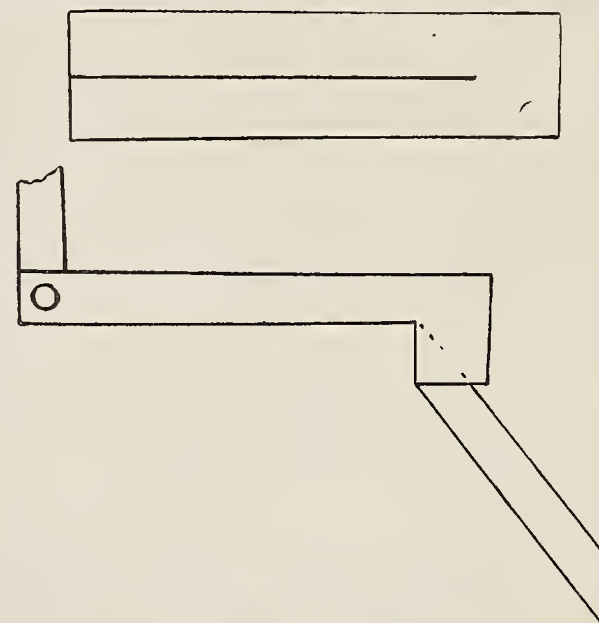
PRINCIPLES OF DYNAMO DESIGN.

BY

Newton Harrison E.E.

(*Continued from page* 14.)

The simplicity of the method is very evident. A piece of paper or cardboard cut into a strip, slit to very near the end and then bent with each piece at right angles to the other, comprises the form of connections used. One strip can be laid upon the other and there will be no in-



FAN-TAIL WINDING.

creasing thickness at ends, as the winding is not cumulative. It is sometimes termed "fan-tail" winding, as the shape of the end connections are similar to the spread of a pigeon's tail. An ingenious mind could evolve some equally efficient method for square head winding, but the basis for them all exists in the Crompton and Swinburne system. Thin end-plates were once adopted by the Edison Co.; this they have passed, and in preference utilize the Eickemeyer winding. By means of end-plates to connect inductor with inductor a gain is perceivable, due to the fact that the area of the plates will allow of extreme thinness and, consequently, little head, as they can be closely placed and easily insulated. The method is expensive and has almost become obsolete. The canvas cover in which the ends of the armature are usually enclosed is in certain machines the very perfection of neatness. The material is braced against a stiff fibre or metal washer at either end and then sewed on as tightly as possible. The binding wires will hold it taut and help it preserve its appearance of uniformity, so desirable in well-finished machines. These canvas covers protect the winding from oil and dust and help very materially to increase its availability.

The kinds of winding as adopted for multipolar machines have already been reviewed under the headings of

Multipolar Armatures $\begin{cases} \text{Multipolar Winding,} \\ \text{Series} \quad \text{"} \end{cases}$

and their distinctive styles as lap and wave winding.

For multipolar armatures the question to be decided is the subdivision of currents. Under each pole there exists a separate circuit whose E. M. F. and current can be either thrown into multiple or series with the rest. To enable such a process to be successfully carried out, the above windings are applicable. Presuming that a drum armature is being employed, and that the machine is four-poled, there will be four brushes used at the commutator and the armature will send four separate currents of equal E. M. F. outwards to be collected. The multiple winding is, of course, adapted to such work, and its figurative design has given it the name of lap winding.

In previous sketches the winding of a drum armature has been illustrated. The flow of the current due to the particular form of winding has divided windings in general into two classes,

Right Handed,
Left "

If the current flows around so as to bring the positive brush at the top, or at the extremity, of a vertical line through the commutator, the winding is right-handed. The current therefore rises in the windings from the left to the right. With the positive pole below, or rather with a winding that brings it below, the direction of current flow is left-handed. By connecting a rising conductor on the left to a descending conductor on the right the advance of the winding would be right-handed in direction, and the converse, left-handed. This "twist" determines the heading under which the winding is to be included in any case. The belt of demagnetizing conductors included between the pole-pieces in the neutral space exercise a depreciating effect upon the field strength. They can be made less effective and their neutralizing tendency considerably diminished by utilizing a method invented by Swinburne called "chord winding."

The simplicity of this is evident. There is a means of winding by which the forward and backward flow of the

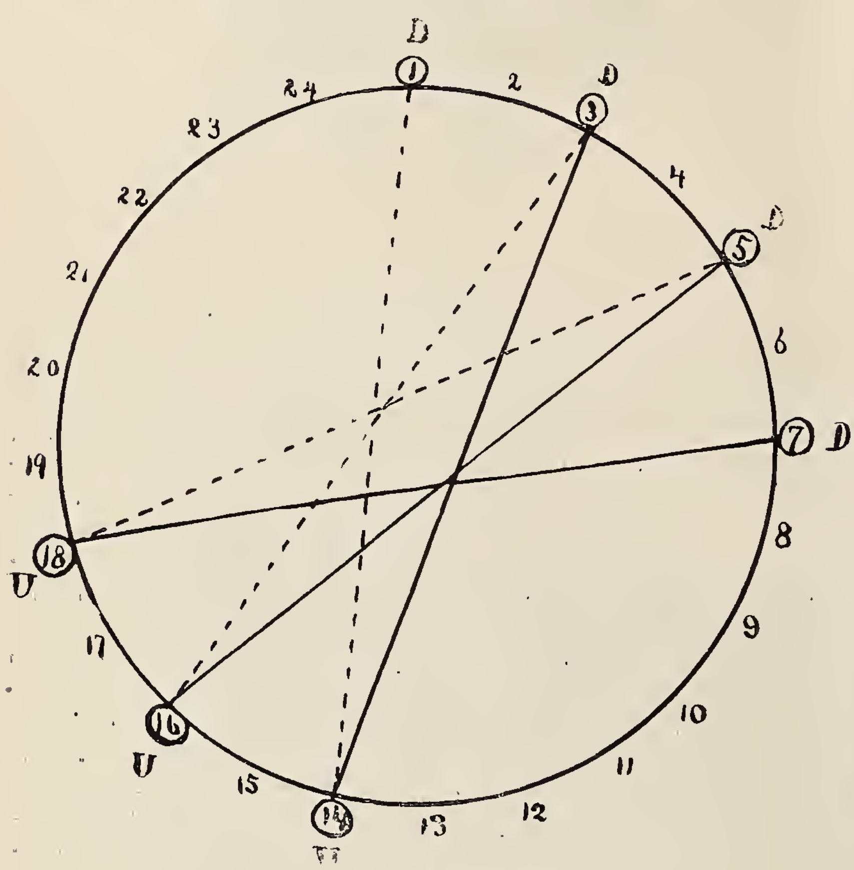


DIAGRAM OF TABLE I.

current can be effected alternately throughout the armature inductors. By this means, having a positive and negative wire respectively lying side by side, the demagnetizing tendency is reduced between the pole-pieces.

This chord winding is very similar, as will be seen further on, to the lap and wave winding of a multipolar armature, only there is a limit to the size of the chord that the wire represents. The greatest possible chord is the diameter, and the best is that which exercises the least demagnetizing action on the field. The most desirable winding will subtend a chord at least equal to that of the pole-piece, and this is the least allowable angle. As the chord may be that of an arc greater or less than 180°, the rule for connections is as follows :

$$\tfrac{1}{2} \text{ I} \pm \text{I}$$

in which I = inductors.

In the case of an armature having 40, 60, or 80 inductors the spacing or advance of the winding would be, according to the above, either 21 or 19, 31 or 29, and 41 or 39. In all cases the object to be attained is an even adjustment of the inductors, so that there are no unfilled spaces and no single winding placed upon another by mistake. The above rule may be modified so as to call for $\tfrac{1}{2}$ I ± 3 instead, and thus reduce the size of the chord. As the reader will observe, the first rule calls for a connection from the first inductor laid on the armature to one which misses the extremity of an opposite diameter either by one too many or one too few. The inductor then precedes or succeeds the previous inductor in every case, either by 180° less or more than the angle of one inductor in the first, or three inductors in the second case.

A winding table may be developed from the idea contained in the foregoing method. Its convenience will appeal to the practical mind, and its use in starting a new winding cannot be gainsaid. The directions are simple and explicit, and may be understood by the following preliminary explanation :

Winding Tables.—The *front* and *back* of an armature are the commutator end and the end opposite to it. Also it may be understood that the wires starting at the commutator or front end are laid *down* the core, while those leaving the back end are laid *up* the core. Thus by appreciating the relative positions of the wires across the front or back ends and either up or down the armature core, the meaning of the symbols above, the following table will become evident :

D means down the armature core.
U " up " " "
F " front or commutator end.
B " back " opposite. "

BIPOLAR DRUM, 24 INDUCTORS.

F	B	F	B	F	B	F

D	U	D	U	D	U
1	14	3	16	5	18
7	20	9	22	11	24
13	2	15	4	17	6
19	8	21	10	23	12

Rule :—$\tfrac{1}{2}$ I + I = pitch.

$\tfrac{1}{2} \times 24 + 1 = 13.$

(*To be Continued.*)

THE EDUCATIONAL VALUE OF ENGINEERING STUDIES.*

BY T. M. DROWN, LL.D.

The educational value of scientific and technical studies as conducted in our great engineering schools has, I think, not been fully understood or appreciated by recent thinkers and writers on pedagogics. Here we have a severe drill in mathematical and mechanical subjects, aided by laboratory practice, which permits the student to handle apparatus and machines and to observe the results of his experiments. Laboratory methods of instruction are now so familiar to us in all branches of science, and seem so obviously necessary to successful instruction, that it is hard to realize that they have had their origin and development in the last two generations. But of far more importance than this great educational method is the training in original research which pervades the engineering school and which, if rightly guided, engenders in the student a love of truth and empowers him to be a successful seeker for it. And with this love and power come self-control, self-reliance and a true humility.

The characteristics of a course in engineering (still using that term to include all studies now grouped under the head of technology) which would satisfy at once the engineer and the educator are :

(*Continued on page* 30.)

* From address delivered at the Lehigh University, on Founder's Day, October 10, 1895.

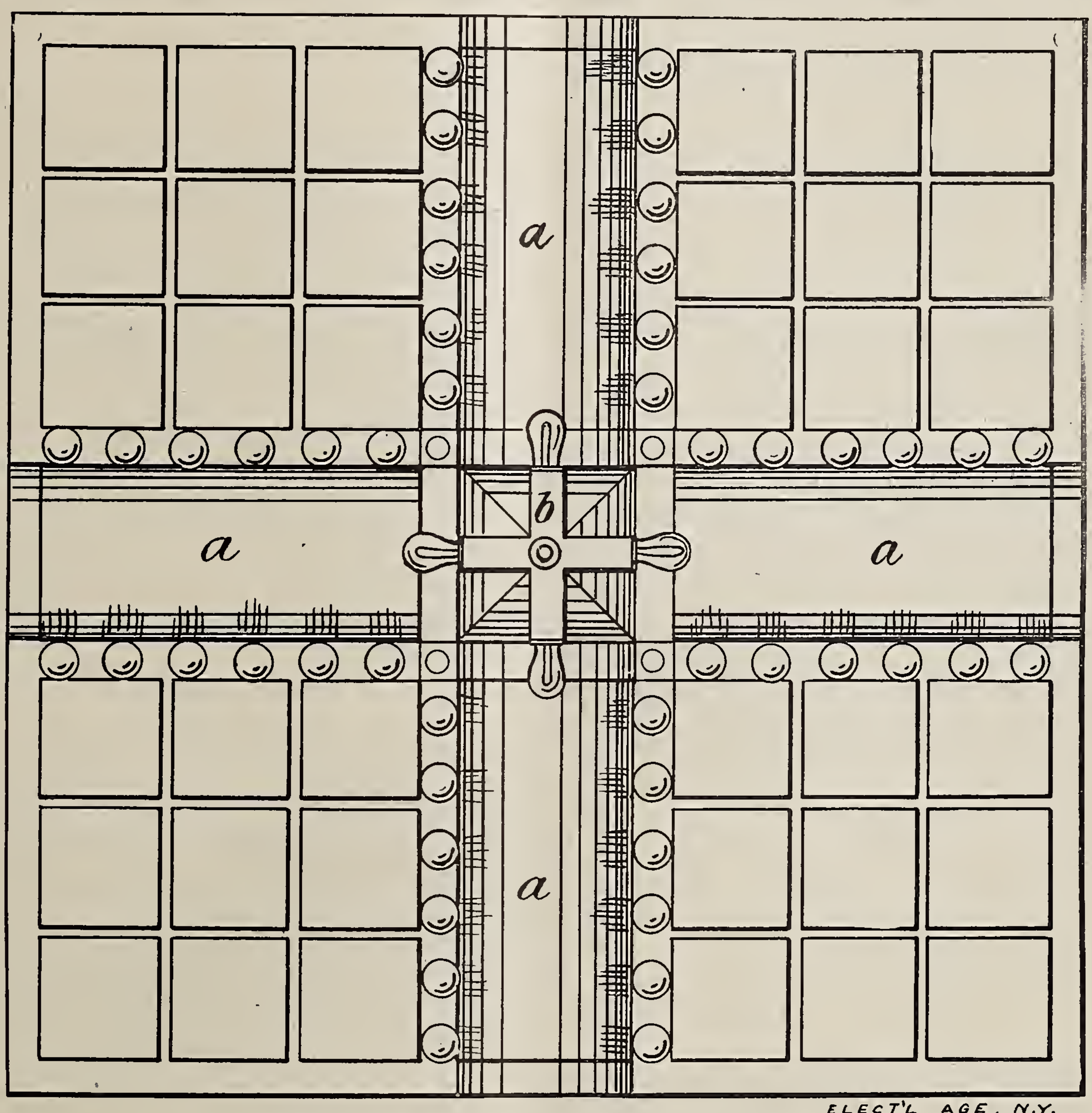
ELECTRICAL ADVERTISING APPARATUS.

A very handsome and ingenious device designed as a medium for advertising purposes is shown in the accompanying illustration.

It is not always that a machine of this character possesses the merit of attractiveness, but this one does, and this feature alone will draw the attention of the public, disregarding for the moment the resplendence of the apparatus when illuminated and in operation at night.

Briefly, the device consists of a frame-work 15 feet square, divided into four sections by semicircular plate-glass mirrors, *a*. At the intersection of these mirrors, at the centre of the frame, the triangular sections of mirror take an oval form.

At the centre are pivoted four metal arms, *b*, at the end of each being an incandescent lamp of a different color from all the others. These revolvable arms are revolved by a small electric motor placed within the frame.



WHEELER'S ELECTRICAL ADVERTISING APPARATUS.

Along the edges of the hemispherical mirrors are placed a series of incandescent lamps, which, when glowing, give a very beautiful effect on the convex surfaces of the mirrors.

In operation the lamps on one corner first flash up for 10 seconds, then the lights are extinguished; the lamps in the second corner next glow for the same period of time, and are then extinguished and followed by the lighting up and extinguishing of the third and fourth corners in succession. When all corners have thus been lighted up successively, all four flash out together for 10 seconds and are then extinguished. The cycle of operations is then repeated.

The revolving arms are in continual motion, and as each arm is longer or shorter than each of the other three, the effect is to produce four rings of colored light on the mirrors at the centre, the colors corresponding with those of the incandescent bulbs.

The four corner spaces of the frame are reserved for advertising purposes. The letters of the advertisements are left blank on the ground glass and the intervening spaces filled in with black paint. Behind the ground glass are placed other incandescent lights, which illuminate the letters of the advertisement, bringing them out in beautiful soft white light against the black ground with very pretty effect.

Altogether this device is one of the most effective of its kind ever produced, and no doubt it will take well with the public and will be a paying investment for those who operate them.

This excellent apparatus is the invention of Mr. Eugene S. Wheeler, who is connected with the Dickinson Electrical Supply Co., 150 Nassau street, New York. Mr. Wheeler has applied for a patent and will sell an interest in it to anyone who wishes to take the thing up on a commercial basis.

EXPOSITION IN MONTREAL.

The British Empire Exposition and International Display of all Nations, which will be held in Montreal, Canada, from May 24 to October 12 next, has opened offices in this city at Room 528, Postal Telegraph Building. Messrs. Hugo Benedix and O. Moser will look after the affairs of the association in this section of the "States." Both these gentlemen are experienced in this line and will exercise considerable influence on behalf of the exposition. Handsome awards for successful exhibitors have been provided.

The plans of the exposition include an electrical building of ample dimensions.

(*Continued from page* 28.)

1. A thorough class-room drill in the fundamental principles of his profession.
2. The broadening and humanizing influence of culture studies throughout his course.
3. The formation of good mental habits.
4. Careful guidance into the realm of original research.

There is no system of education, however thoughtfully and ingeniously devised, which can do away with class-room drill in fundamental mathematical subjects. A workman must have fitting tools for his work and must thoroughly understand their use. The engineer must be firmly grounded in his mathematics, physics, and mechanics, so that his mind works in mathematical channels without effort. This is his necessary equipment as engineer; but in acquiring this mathematical facility his mind becomes at the same time trained in accurate, logical thinking, and his whole mental and moral fibre becomes strengthened. Specious reasoning repels him, for the quickened intellect detects fallacy. The engineer thus gains in his mathematical training the first qualification of the educated man.

DEPARTMENT OF ELEMENTARY EDUCATION.

BY THE EDITOR.

[*Note.—Any one is invited to ask questions on any point that is not made clear in these articles. Suitable explanations will be cheerfully given under the head of " Answers to Inquiries."*]

ELECTRIC BELL CIRCUITS—CONTINUED.

(*Continued from Page* 17.)

Having thus described the simple bell circuit, the reader will be prepared to understand the application of the principle to the more complicated circuits described and illustrated below.

Fig. 2 shows one bell operated by two push-buttons, one push, say, at the front door, and the other in the dining room, to call the servant during meals. It will be noticed that this circuit is the same as the one shown in Fig. 1 in our last paper, with the extra push-button added, *in multiple.*

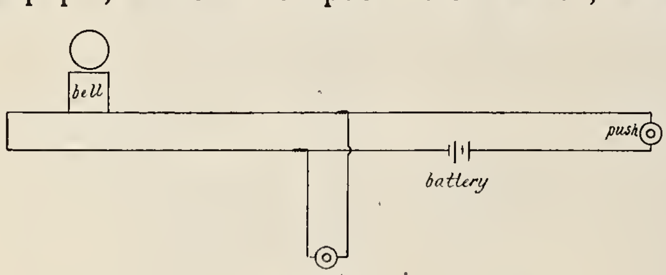


FIG. 2.

" In multiple " means *across*, or between, two wires. In order to make the wire connection, an inch or two of the main wires must be bared of their covering, at the point where the wires of the extra push-button are to be connected. The ends of the latter wires must also be bared

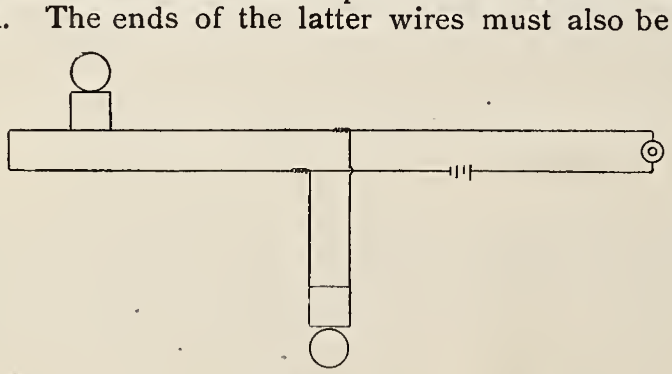


FIG. 3.

and cleaned, and then twisted around the main wires, where the insulation has been removed. The joint should be made as firm and tight as possible, to insure a good, strong contact. Either push-button will ring the bell.

Fig. 3 shows a circuit with two bells and one push-button; one bell, say, in the kitchen, and one in the servants' or any upstairs room. In this case the bells are connected in multiple, as the push-buttons are in Fig. 1.

In putting two vibrating bells on the same circuit they should always be connected in multiple, and not in *series*, that is, one after the other on the same wire. When they are connected in series the chances are that neither bell will ring, because they interfere with each other. There is no interference at all when they are connected in multiple

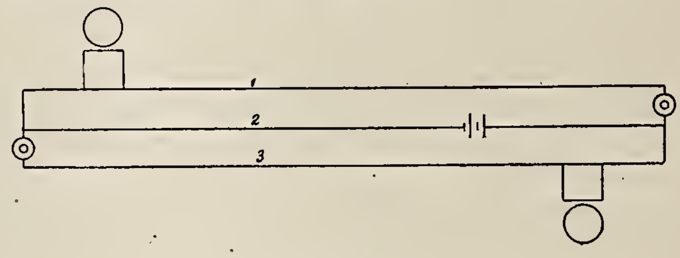


FIG. 4.

—one bell could be removed and the other would work just the same.

Sometimes it is desired to have two independent circuits in the same building. Obviously we can run as many independent circuits as we wish, but suppose we have only one battery and a limited supply of wire. We must, therefore, devise some way of having the two circuits operated from one battery and with the least amount of wire. Such a circuit is shown in Fig. 4. A circuit of this kind would be applicable where we wish to have a regular front-door push, with the bell in the kitchen and the other push-button in the mistress' chamber and its bell in the servant's room, for the purpose of calling the domestic up in the morning.

This circuit could be used also as a call and an answer back. It could be run between house and stable; for in-

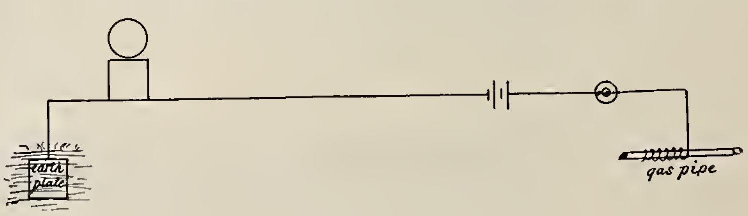


FIG. 5.

stance, with the bell on wire 1 and the push on wire 3 in the house, and the bell of wire 3 and push of wire 1 in the stable, or any other distant part of the premises, a regular system of signals and replies could be carried on.

In setting up a circuit of this kind care must be taken to place the battery in the position shown with reference to the bells and push-buttons. Such a circuit consists really of a simple circuit, like Fig. 1, with an extra push-button and bell connected on both sides of, or around, the battery.

We could connect other push-buttons if we wished to ring either bell from any other part of the house, by connecting the extra wires to wires Nos. 1 and 2, or 2 and 3.

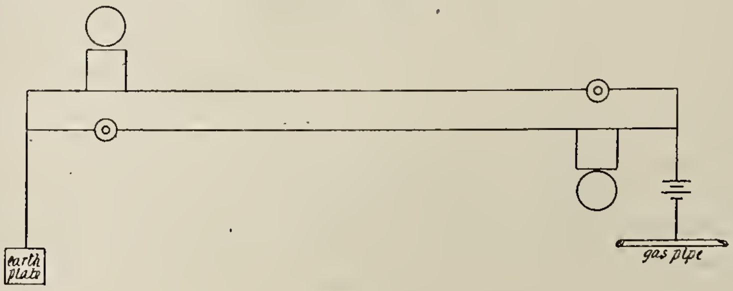


FIG. 6.

We could also ring both bells with one push, by connecting the push-button with wires Nos. 1 and 3.

Some people want electric bells and push-buttons all over the house, so that they can from any part of the house call the servant, wherever *she* may be. Fig. 5 shows a circuit with three push-buttons and three bells, all bells being rung by any one push.

It is well known that the earth, or ground, can be utilized as a conductor instead of a wire, and is often so used in bell work where the circuits are long; for instance, from one building to another some distance away. As the earth is common property, it costs nothing to use it as a conductor, and it takes the place and saves the cost of one wire between the two ends of the circuit.

The usual way of making a connection with the earth, or ground, is to tightly wind the end of the bare wire around the gas-pipe or the water-pipe. The metal of the pipe becomes a conductor, and as it lies underground and is in direct contact with the earth, a good ground connection is thus obtained.

In localities where there are no gas or water-pipes ground connections are secured by burying plates of metal in the ground, the end of the wire being connected to the plate. The larger the surface of the plate the better "ground" we will get.

Suppose, now, we wish to run a call-bell circuit from office to factory, two blocks away, say; such an arrangement, using the ground as one wire, is shown in Fig. 5. This circuit provides for calling in one direction only. Should it be desired to provide means to signal either way, two wires must be run and the ground used as the third wire, as shown in Fig. 6.

ANSWERS TO INQUIRIES.

[*Note.—This column is open to any of our readers who desire special information on any subject. In case we cannot give the desired information ourselves the inquiry will be published, in order to elicit a reply from some one of our readers. These answers will be published in due course.*

The full names of our correspondents will not be published, but for the purpose of identification their initials or other mark of identity will be substituted therefor.

Each question will be numbered for the purpose of ready reference.

All are invited to make free and liberal use of this column.]

7.—Why are alternating-current dynamos easier to build than direct-current machines? D. S. M., Erie, Pa.

A.—Mainly because there is no commutator on the armature. The commutator is regarded as the weak point of direct-current machines, and great care must be taken in its construction. In alternating-current dynamos all of the armature coils are connected with two rings, which take the place of the commutator or the direct-current dynamo.

8.—What is a "step-up" transformer? R., Hudson, Ohio.

A.—A step-up transformer is one used to raise the voltage of the current generated by an alternating-current dynamo in order to transmit the current long distances. At the other end the voltage is reduced to workable limits by proper transformers.

9.—Are there any electric railroads with the conductors underground in successful operation in this country? T. H. S., Keokuk, Ia.

A.—Yes; there is one in Washington and one in New York City. The former is the Love system, and is working quite successfully. The Metropolitan Traction Co., New York, operates its Lenox Avenue line on an underground conduit system of the General Electric Company. In our opinion it is the finest piece of road to be found anywhere. The electric system, as far as we can learn, is giving excellent satisfaction.

10.—Glass is said to be one of the best insulators; has its resistance ever been measured? R., Troy, N. Y.

A.—Kempe gives the resistance of glass as about 22,700,000,000,000,000 times that of copper. In this connection it may be of interest to state that the same authority gives the resistance of gutta-percha as 350,000,000,000,000,000,000,000.

11.—I notice that the circular mil is used as the unit of measurement of the diameter of electric wires. Will you please inform me through "Answers to Inquiries" column what a mil is and how it is used as a measure, and oblige. R. S., Elkhart, Ind.

A.—A mil is $\frac{1}{1000}$ of an inch, and a circular mil is the area of a circle with a diameter of one mil. A wire with a diameter of three mils has an area of nine circular mils. Tables are given in many electrical books showing the area in circular mils of all sizes of wire. The smallest wire used in practical work is No. 40 gauge, and has an area of 9.88 circular mils.

12.—What is the object of the third wire in the Edison three-wire system of distribution? R. H. P., Bellevue, Ohio.

A.—The primary object of the third wire is to save copper—that is, in the form of wire. The three-wire system was designed to make it possible to carry current a much greater distance from the dynamo than is practicable with two wires without great loss of power. The amount of copper necessary to distribute current for a given number of lamps by the three-wire system is about three eighths of that required to carry the same current by the two-wire system.

THE OKONITE COMPANY, LTD.

This enterprising company, whose product is a veritable electrical household word, is now in the tenth year of its existence. Its birth dates back to 1884, when J. J. C. Smith, Michael Smith and Herman Gelpcke organized the New York Insulated Wire and Vulcanite Co., and established a plant at College Point, L. I., N. Y. These gentlemen began at once the manufacture of a special form of insulation which has become known throughout the world as "Okonite." The name of the company was in 1885 changed to The Okonite Company, and again, on its reorganization in 1889, to the Okonite Company, Limited. The present management consists of the well-known gentlemen, Capt. Willard L Candee and H. Durant Cheever, managing directors; George T. Manson, general superintendent, and W. H. Hodgkins, secretary. The company's headquarters are at 13 Park Row, New York City, and its factory, which is an immense plant, is located at Passaic, N. J. The Company maintains agencies in London, Rome, Yokohama, Shanghai, Buenos Ayres, Chicago, Boston, St. Louis, San Francisco, Philadelphia, Omaha, Cincinnati, Kansas City, Pittsburgh and Buffalo.

At the works crude oil is used for fuel, there being tank storage capacity of 60,000 gallons. The power plant for manufacturing purposes consists of a 250-horse power engine, and in addition to the steam power, 200-horse power is available from the Dundee Canal, which runs past the factory. Three small engines run the dynamos.

In every department the plant is complete and specially adapted for the particular work carried on in each. Everything in the electrical conductor line is produced here, from the smallest to the largest.

Views of the different departments of this immense establishment are shown in the inset which accompanies this issue, and a faint idea of the extent of the plant may be gained therefrom.

ELECTRICAL DECORATIONS AT THE ZIMDARS & HUNT EMPLOYÉS BALL.

In our issue of December 21 we made a brief reference to the second annual ball of the Associated Employés of the Electrical Firm of Zimdars & Hunt, of this city, which was held at the Central Opera House, New York, on the night of December 16. We were promised a photograph of the splendid electrical decorations in time to reproduce in the issue of the following week, but its delivery was delayed. We are now able to show an illustration of the artistic work, which reflects great credit on the taste and skill of those who had the matter of decoration in charge.

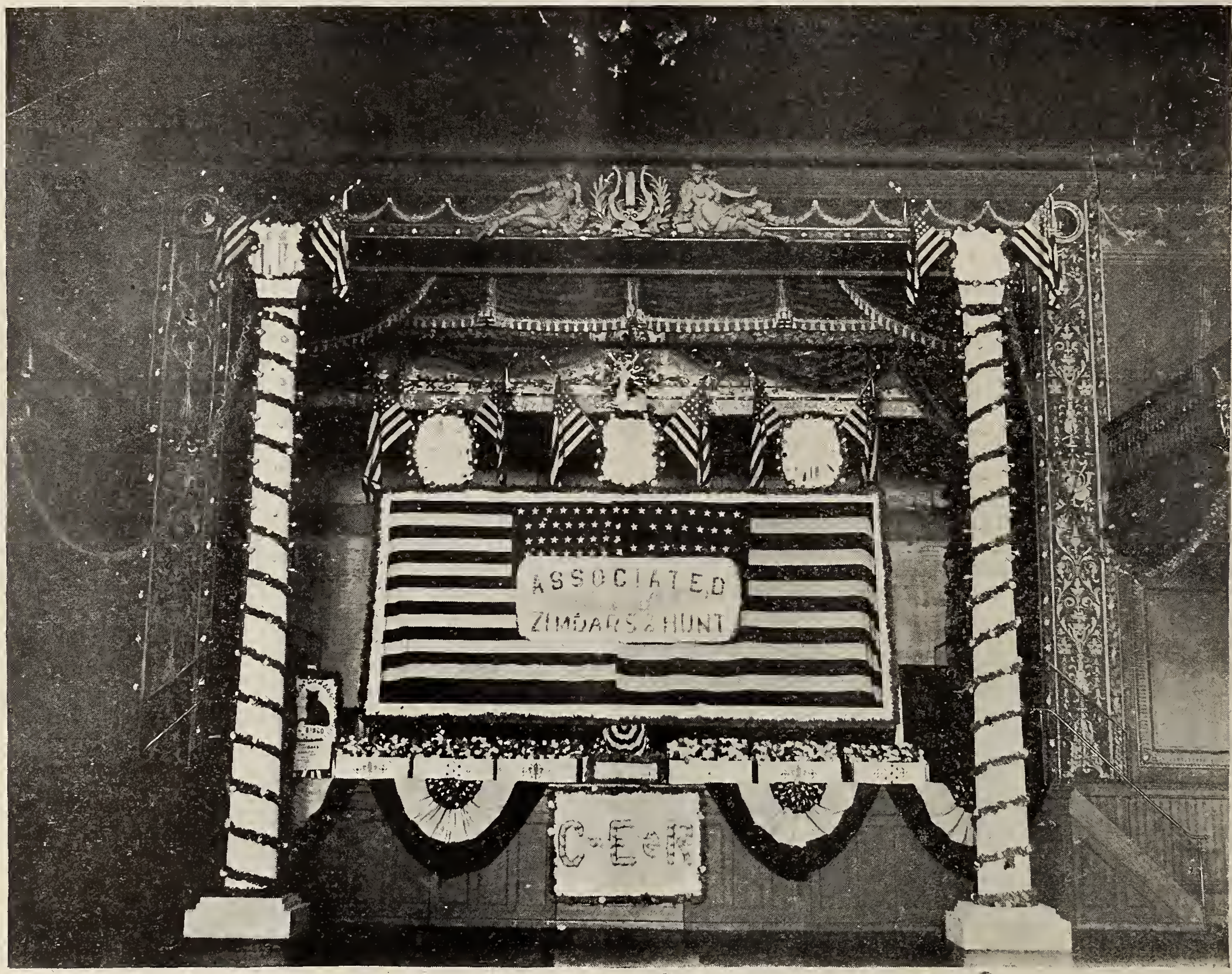
When the four hundred or more people arrived at the Opera House they were fairly startled by the splendor and magnificence of the electrical decorations, which were such as had never been seen before at either a public or private reception. The walls were covered with ever varying designs in intricate workmanship, and tasteful assortment of color. Every mechanical and electrical device in use to date had been utilized in the work, and the result drew forth enthusiastic admiration from the guests assembled. The fact that the work was all done by the hosts themselves, the employés of Zimdars & Hunt, made it doubly effective.

Not the least wonderful of the decorations was the dancing programme, which appeared on the wall in incandescent electric lights. Each dance in this way was announced in turn, in a scintillating stream of fire.

The grand march was led by Mr. J. P. Smith, the floor manager. After that the regular order of the programme was carried through, until the time arrived for the dancers to partake of the elaborate supper which awaited them. Then the dancing recommenced and continued until the small hours of the morning.

All who took an active part in the arranging and management of the ball deserve hearty praise for the thoroughness of their work. This especially applies to Mr. Vielberth, the chairman of the floor, to whose efforts and able guidance a great part of the success of the evening belongs. He left no stone unturned in his laboring to see that everybody present should enjoy himself or herself to the utmost.

The full staff of management was as follows: Geo. T. Butler, president; Geo. Ruckle, vice-president; Geo. J. Murphy, recording secretary; W. H. Hunt, treasurer; Chas. L. Stephan, financial secretary; John F. Sutcliff, sergeant-at-arms; J. P. Smith, floor manager; James Galvin, assistant floor manager; J. F. Vielberth, chairman of the floor. Floor Committee: Chas. Schwendermann, F. S. Roberts, Chas. Miller, Arnold Fox, Louis Ruckle, P. H. Morgan. Reception Committee: J. P. Bell, chairman; W. E. Kock, Robt. E. Butler, R. Wilson, E. K. Wendler. Saml. Titterington, chairman of arrangements. L. J. Daniels, chairman of press.



ELECTRICAL DECORATIONS AT BALL OF EMPLOYÉS OF ZIMDARS & HUNT, NEW YORK.

PECKHAM SPECIAL TRUCKS.

Coincident with the development and improvement of electrical apparatus, track construction, etc., for electric railways, progress in truck building has kept apace.

One of the most enterprising truck building companies is the Peckham Motor Truck and Wheel Company, New York. This company has the facilities to design and produce trucks to meet any extraordinary requirement, and its standard trucks have a rapidly expanding market.

The Peckham Company has recently brought out three new trucks that deserve special mention.

The truck shown in Fig. 1 is a swivel, or bogie, truck of novel design. In this truck Mr. Peckham has embodied all of the special features which characterize Peckham trucks, such as double truss, hot-riveted side frames, and axle boxes, and added the bogie principle for special service. The centre support is, in fact, almost the same as that used on the New York Central's "Chicago Limited" train. The car body rests upon a truss supported on half-elliptic springs mounted upon the side frames, which are in turn cushioned on the springs of the "flexible gear," which is one of the most valuable features of the Peckham truck.

This arrangement gives a remarkably easy-riding truck, which is so much appreciated by the public and which has so little effect on the rail joints.

The motor suspension bars are supported on the side frames of the truck in the usual manner.

The brakes are very powerful and easily applied. All parts of this truck are carefully made and machine fitted, insuring freedom from noise and lost motion.

The "Extra Long" and "Extra Strong" truck (Fig. 2) was built by the Peckham Company especially for the

Electric Storage Battery Company, Philadelphia, for use on the Madison Avenue line, New York City. The motors, which are of the G. E. 800 type, are supported on trusses mounted on spring supports outside of the boxes, so as to

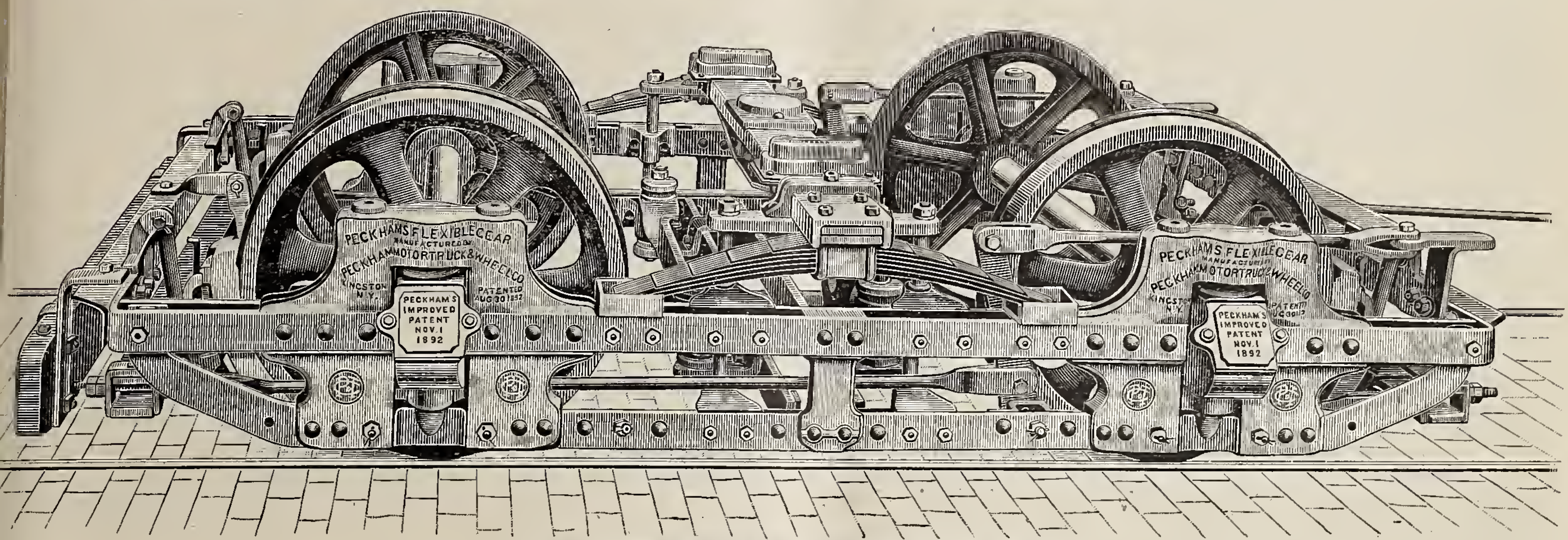


FIG. I.—PECKHAM SWIVEL OR BOGIE TRUCK.

leave a large, open space between the two axles for the reception of the storage batteries. A strong platform is suspended through springs, from the side frames, and upon this platform is placed the tray carrying the storage batteries.

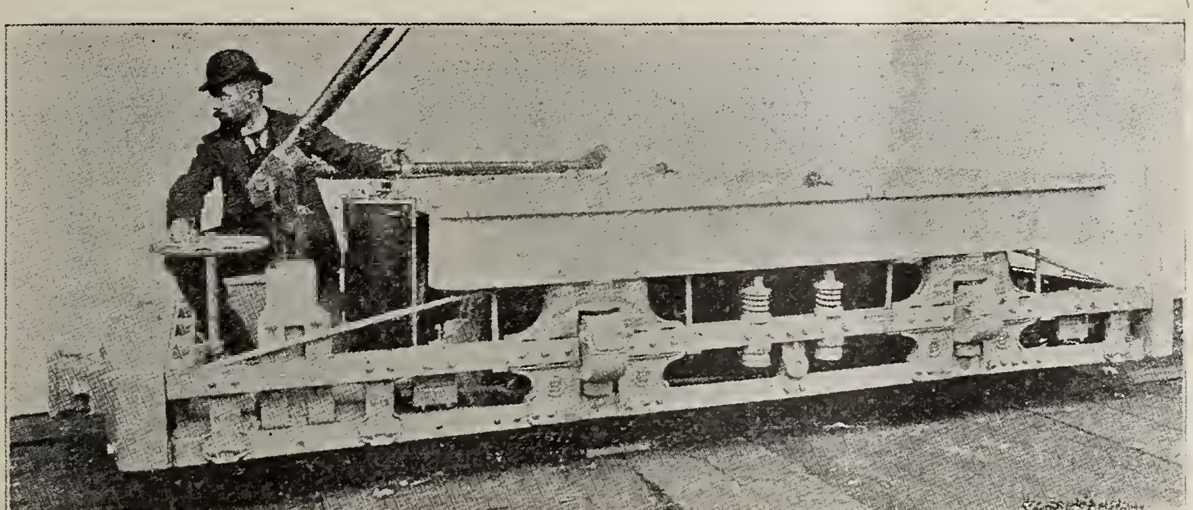


FIG. 3.—PECKHAM'S MINING TRUCK.

The side frames are of the usual Peckham pattern, but made extra strong to provide for the increased length of spring base, which in this case is 16 feet.

The mining truck, shown in Fig. 3, is designed in such

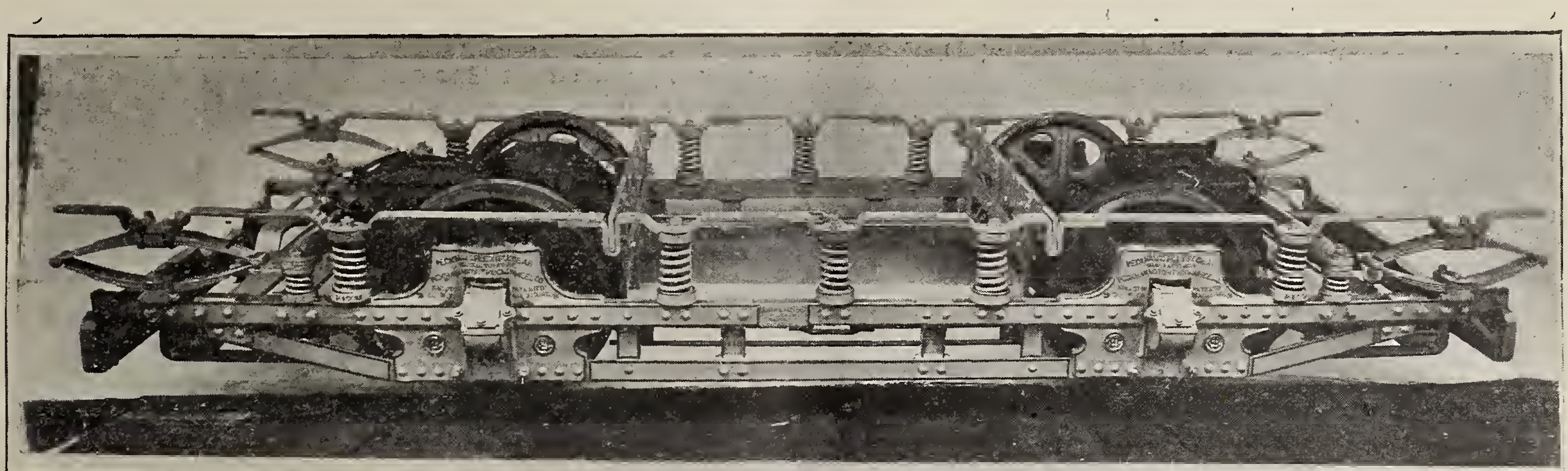


FIG. 2.—PECKHAM'S EXTRA LONG TRUCK FOR STORAGE BATTERY CARS.

a manner as to make it applicable to use on street railways as an inspection or construction car. The side frames have been extended at one end to provide a platform for the controller, brake wheel and trolley support. Over the axle boxes is a heavy platform for carrying tools, derricks, etc. Each of these trucks is in every way up to the standard of the Peckham Motor Truck and Wheel Company, and designed with special reference to the work it will be called upon to perform.

NEW TELEPHONE COMPANIES.

Dolgeville, Wis.—Southwestern Telephone and Construction Co. Capital, $2,000. Incorporators, Henry Halvorson, John M. Reese and George B. McAfee.

Estherville, Ia.—The Estherville Telephone Co. filed articles of incorporation with the Secretary of State. The company has a capital of $25,000, and will construct and operate exchanges in Estherville, Emmett County. Incorporators, C. W. Crim, M. K. Whelan, E. J. Breen and F. E. Allen.

Mt. Ayr, Ia.—The Clearfield and Lenox Telephone Co. has filed articles of incorporation with the Secretary of State. Capital, $1,600. Incorporators, George Meyers, president; R. S. Spurrier, secretary; Henry Baum and F. A. Ferguson, directors.

Madison, Wis.—The Dane County Telephone Co. Capital, $30,000. Incorporators, Bascom S. Clark, Robert N. La Follette, Samuel A. Harper and others.

Harrisonville, Ill.—Harrisonville Telephone Co., incorporated. Capital, 8,000. Incorporators, Samuel C. Skeel, Samuel S. Skeel and John A. Jakle.

Pine Bluff, Ark.—The Pine Bluff Telephone Co. has been incorporated with W. H. Parker, president. Capital stock, $25,000.

—Mr. Elmer P. Morris, of the Cincinnati office of the General Electric Co., is in town this week.

Telephone Notes.

Shenandoah, Pa.—The Shamokin Valley Telephone Co. will commence work in erecting poles, and expect to have the line ready within a month. The line will connect Shamokin, Sunbury, Mt. Carmel and other towns in that county.

Milwaukee, Wis.—The National Telephone Company has applied to the Common Council of Milwaukee for a franchise. If a franchise is granted them, the city will be privileged to use their poles and conduits for stringing police and fire-alarm wire.

Mechanic Falls, Me.—The New England Telephone and Telegraph Company is to open an exchange at Mechanic Falls.

TELEPHONE PATENTS ISSUED JANUARY 7, 1896.

Telephone Switch. George W. Coy, Milford, Conn. (No. 552,516.)

Telephone Transmitter. Isidor J. Kusel, St. Louis, Mo. (No. 552,689.)

Telephone Switch. George W. Coy, Milford, Conn. (No. 552,705.)

Multiple Switchboard System for Telphone Exchanges. Charles E. Scribner, Chicago, Ill. (No. 552,723.)

Multiple Switchboard System for Telephone Exchanges. Charles E. Scribner, Chicago, Ill. (No. 552,724.)

Spring-Jack for Telephone Switchboards. Charles E. Scribner, Chicago, Ill. (No. 552,725.)

Switchboard System for Telephone Exchanges. Charles E. Scribner, Chicago, Ill. (No. 552,726.)

Annunciator for Telephone Switchboards. Charles E. Scribner, Chicago, Ill. (No. 552,727.)

Multiple Switchboard. Charles E. Scribner, Chicago, Ill. (No 552,728.)

Spring-Jack Switch. Charles E. Scribner, Chicago, Ill. (No 552,729.)

Telephone Circuit. Charles E. Scribner, Chicago, Ill. (No. 552,730.)

Telephone Switchboard and Circuit. Thomas C. Wales, jr., Boston, Mass., and Theodore Spencer, Philadelphia, Pa. (No. 552,734.)

Trunk Line for Telephone Exchanges. Thomas C. Wales, jr., Boston, Mass. (No. 552,735.)

Telephone. Norval L. Burchell, Washington, D. C. (No. 552,816.)

Telephone System. Frank R. Colvin, New York. (No. 552,823.)

Telephony. Frank R. Colvin, New York. (No. 552,865.)

Telephone Switch. George W. Coy, Milford, Conn. (No. 552,866.)

Desk Telephone Apparatus. George W. Coy, Milford, Conn. (No. 552,867.)

SPEAKING-TUBE TELEPHONES.

The Metropolitan Telephone & Telegraph Co., of New York, is supplying special telephones called "Speaking-Tube" telephones for use inside of buildings. This name is given the instruments to distinguish them from telephones used for talking over considerable distances. They are neat, sightly and easy to handle, and are supplied in different forms suitable for different situations.

New Corporations.

Kansas City, Mo.—The Southwestern Light Company has been incorporated with E. L. Martin, G. M. Meyers, J. McD. Trimble, C. A. Braley and A. E. Stilwell, trustees. Capital stock, $300,000. To construct and operate gas and electric-light plants in Joplin, Webb City, and other towns.

Brainerd, Minn.—Brainerd Traction, Light and Power Company has been incorporated by C. N. Parker, E. C. Gibson, P. A. Gibson, to construct and operate street-railways, electric lights, etc. Capital stock, $300,000.

Hawkinsville, Ga.—The Hawkinsville Electric Light, Heat, Power and Water Company has been incorporated by W. F. Taylor, W. H. Markmand and others, to construct an electric road.

Jersey City, N. J.—Tilman Electric Lamp Co. has been incorporated by John A. Sullivan, Chas. I. Henry, C. Dunler, J. H. Ahern, Richford Walford, J. Rosseler. Capital stock, $200,000.

Blackstone, Mass.—Blackstone Electric Light Co. has been incorporated, with Robert B. Taber, president, and Jeremiah Getchell, treasurer. Capital stock, $10,000.

Nashville, Mich.—Nashville is to have another telephone line in the near future.

Northfield, Vt.—W. E. Nichols is agitating a local telephone exchange to take in the village of Northfield and a radius of about two miles.

Lexington, Ky.—The New Interstate Telephone Co. is to build an exchange in Lexington. Work will be begun in March.

Bedford City, Va.—Chas. L. Mosby will want about fifty telephones, switchboards, poles, cross-arms, wire, etc.

Saco, Me.—The Electric Railway Switch and Supply Co., organized for the purpose of manufacturing and dealing in electric railway motor and station switches and railway supplies. Capital, $100,000. President and treasurer, Leonard O. Davis, of Springfield, Mass.

Trenton, N. J.—The Pacific Cable Co. has been incorporated by Ex-mayor Abram S. Hewitt, of New York; Col. Fred Grant, N. Y.; G. M. Dodge, D. O. Mills, Jas. J. Hill, Jno. H. Browning, and others, to construct, maintain and operate an electric submarine cable for the transmission of messages from San Francisco to the Hawaiian Republic. Capital stock, $1,000,000.

Nutley, N. J.—The Nichols Electric Light and Power Co., incorporated. The company will erect buildings and poles, and string wires necessary in its business of furnishing electric light and power to the customers. The capital stock is placed at $50,000, and the incorporators are Thomas, John and William Nichols, and Richard T. Noble, all of Franklin.

New York, N. Y.—Chapin Douglass Electric Co. has been formed with Chas E. Chapin, president; J. S. Douglass, secretary and treasurer, for the manufacture of electrical supplies, 136 Liberty street.

Possible Contracts.

Lebanon, Pa.—J. M. Shenk, of Lebanon, and Philadelphia capitalists are desirous of connecting Reading and Lebanon by a trolley line.

Long Branch, N. J.—The Long Branch Commission granted the Atlantic Coast Electric Railway Company a franchise to cross Cedar Park, Lincoln and North Lincoln avenues.

Springfield, O.—Plans are now on file at the office of the architect, John I. Renaker, Franklin Life Building, for the hotel to be erected by C. W. Freeman. In the basement will be located boilers, engines, dynamos and laundry, passenger and freight elevators.

Ridley Park, Pa.—R. S. Pomeroy can give particulars as to the proposed construction of the electric-light plant.

Springfield, Ill.—Plans have been prepared for a hotel to be erected by C. W. Freeman. The hotel will be provided with its own electric light plant.

Hartford, Conn.—A trolley road is to be built by F. E. Wardwell, of the Wardwell Bros., builders of electric roads, and others, from Danbury to Golden's Bridge and the Harlem Road, 14 miles.

Middletown, Pa.—The Harrisburg Club is contemplating the erection of a new club house at a cost of about $30,000.

Norwich, Conn.—The Connecticut Engineering Company of Norwich, George W. Phillips, president, closed a contract with Wm. C. Clark, of Wakefield, R. I., for the construction of the Sea View railway from Watch Hill, through Point Judith and Narragansett Pier to Wickford. Also for the Narragansett electric railway from Kingston Junction to Narragansett Pier. The two roads will extend over 40 miles, and their completion will cost $500,000.

Richmond, Va.—Plans are invited for the erection of a new court house to cost no more than $20,000. Address the Henrico County Supervisors.

Sheffield, Ala.—The Consolidated Water, Light and Power Company wants a 2500-light electric outfit, two 50 horse-power motors, two 500,000 gallon pumps run by electricity, pipes, etc.

Cripple Creek, Col.—F. B. Edbrooke, of Denver, has prepared plans for a proposed hotel and theatre to be erected at Cripple Creek by J. N. Wolfe. Estimated cost, $100,000.

Boston, South Boston, Mass.—A new hotel is to be erected at the corner of Broadway and A street, South Boston, by James Casey. The structure will be of brick, five stories in height and will face on Broadway.

New York City.—Frederick P. Foster, 52 Wall street, will erect four two-story brick store and office buildings at 2163–2169 Eighth avenue, at a cost of $20,000.

Parah S. Wyckoff, 240 West 43d street, will erect a four-story brick store and office building on Sixth avenue south of 14th street, at a cost of $10,000.

Newark, N. J.—The Board of Directors of the Newark Library Company, or Association, has decided to sell the building now occupied by the Free Public Library. The property is valued at $100,000. The Free Library Trustees have decided to build a structure larger and better than the present one.

Easton, Pa.—Rader & Bros. dry goods store, now one of the largest in Boston, is to be increased to more than double its present size.

Columbia, S. C.—The Columbia Street-Railway Company will extend its trolley line three miles. Address J. Q. Marshall, president.

Graham, Va.—Construction of the Graham-Bluefield Electric Railway Company has been begun. The road will be three and a quarter miles long. Bonds to the amount of $15,000 per mile will be issued to pay for the line.

Portsmouth, Va.—The Portsmouth, Gilmerton & Smithfield Railway Company has asked the legislature for a charter to build an electric line from Portsmouth to Smithfield.

Alexandria, Va.—The Washington, Alexandria & Falls Church Company has been authorized by the Virginia Legislature to extend its lines in Virginia.

East Liverpool, O.—A project is being considered to build a trolley line from East Liverpool to Rock Springs, W. Va., by a syndicate including J. E. McDonald and W. L. Smith, of East Liverpool; John Schroder, of Pittsburgh, and G. P. Pust, of Cleveland.

THE HENRY ELECTRICAL CLUB.

Prof. M. I. Pupin will deliver a lecture on Transformers at the meeting of the Henry Electrical Club, on the night of January 17, at 111 to 115 West 38th street, New York. The lecture will be illustrated by many brilliant experiments.

Trade Notes.

The New York Carbon Works, 39 & 41 Cortlandt street, New York, have issued a catalogue and price-list of their well-known goods. They make carbons for motors of all makes, generators and batteries, and supply granulated carbon and dust in large or small quantities.

Mr. James E. Woodbridge, for many years at the head of the small-tool department of the Pratt & Whitney Company of Hartford, Conn., has recently acquired an interest in, and become identified with the Brady Manufacturing Company, Brooklyn, N. Y., as its president, where he will be pleased to see or hear from his old friends and customers. It is now the intention of the Brady Mfg. Co. to take up the manufacture of a full line of small tools of every description in addition to their regular business of special automatic and labor-saving machinery; special tools and fixtures, including plants for the manufacture of specialties.

The Commercial Cable Company has issued a very neat calendar for 1896. It has a leaf for every week, and at the back of the pad are several leaves containing some valuable and interesting information for the business public.

The Benedict & Burnham Mfg. Co., 13 Murray street, New York, are sending out to electric light and power stations a copy of their new price list of bare and insulated wires.

The Houston Plumbing & Mfg. Co., Houston, Texas, has opened an electrical department and desires catalogues of electrical goods. The concern has the best of references.

Harry M. Shaw, 126 Liberty street, is hustling hard in pushing the self-lubricating motor and generator brushes of the Partridge Carbon Co., Sandusky, Ohio, of which concern he is the New York agent. He knows he is dealing in a good thing and wants everybody else to know. That's right and business.

ELECTRICAL and STREET RAILWAY PATENTS

Issued January 7, 1896.

552,516. Telephone Switch. George W. Coy, Milford, Conn. Filed March 15, 1895.

552,521. Electric Motor. Stephen D. Field, Yonkers, assignor to the Otis Brothers & Company, New York, N.Y. Filed June 27, 1892.

552,540. Electric Meter. William H. McGrath, Fort Wayne, Ind., and John M. Oram, Dallas, Tex. Filed July 8, 1895.

552,542. Apparatus for Protecting Electrical Circuits. John M. Oram, Dallas, Tex. Filed June 4, 1895.

552,553. Phase-Completing Device. James T. Sibley, Clinton, Canada, assignor, by mesne assignments, to John M. Drysdale, trustee, New York, N. Y. Filed March 28, 1893.

552,574. Electric Switch. Sigmund Bergmann, New York, N. Y., assignor to the General Incandescent Arc Light Company, same place. Filed April 23, 1895.

552,594. Electric Gas-Lighting Burner. Joseph E. Swendeman, Boston, assignor to George F. Pinkham, Wollaston, Mass. Filed June 7, 1895.

552,604. Electric-Railway System. Henry Brandenburg, Chicago, Ill. Filed October 5, 1894.

552,631. Trolley. Bert Dale, Milwaukee, Wis. Filed May 9, 1895.

552,639. Car Guard or Fender. John Gibbons, West Troy, N. Y., assignor of two-thirds to Fayette B. Durant and Luhr Eggers, Jr., same place. Filed May 16, 1895.

552,655. Car-Fender. William P. Young, Pottstown, Pa. Filed July 18, 1895.

552,658. Junction Fuse and Switch Box. William F. Bossert, Utica, N. Y. Filed April 3, 1895.

552,680. Electric Cut-Out and Insulator. Herbert A. Wagner and Ferdinand Schwedtmann, St. Louis, Mo. Filed January 21, 1895.

552,689. Telephone Transmitter. Isidor J. Kusel, St. Louis, Mo. Filed April 29, 1895.

552,705. Telephone Switch. George W. Coy, Milford, Conn. Filed April 5, 1895.

552,723. Multiple Switchboard System for Telephone Exchanges. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed March 5, 1892.

552,724. Multiple Switchboard System for Telephone Exchanges. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed March 17, 1892.

552,725. Spring-Jack for Telephone Switchboards. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed July 30, 1892.

552,726. Switchboard System for Telephone Exchanges. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed April 26, 1893.

552,727. Annunciator for Telephone Switchboards. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed May 2, 1893.

552,728. Multiple Switchboard. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed June 1, 1889. Renewed May 5, 1893.

552,729. Spring-Jack Switch. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed May 9, 1893.

552,730. Telephone Circuit. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed June 16, 1893.

552,733. Automatic Electric Alarm. Thomas J. Stansel, Laredo, Tex., assignor of one-half to A. Winslow and A. Thaison, same place. Filed June 1, 1895.

552,734. Telephone Switchboard and Circuit. Thomas C. Wales, jr., Boston, Mass., and Theodore Spencer, Philadelphia, Pa., assignors to the American Bell Telephone Company, Boston, Mass. Filed July 25, 1895.

552,735. Trunk-Line for Telephone Exchanges. Thomas C. Wales, jr., Boston, Mass., assignor to the American Bell Telephone Company, same place. Filed August 24, 1895.

552,738. Printing Telegraph. Jonathan E. Woodbridge, Duluth, Minn. Filed October 7, 1895.

552,755. Conduit System for Electric Railways. Charles A. Gaines, New York, N. Y., assignor of one-fourth to George Herman Gillette, same place. Filed May 1, 1894. Renewed November 19, 1895.

552,756. Electric-Circuit Controller. Hermann A. Gorn, New York, N. Y. Filed July 26, 1895.

552,776. Electric Signaling. Frank G. Pratt, Revere, Mass., assignor to the Union Switch and Signal Company, Swissvale, Pa. Filed August 20, 1894.

552,789. Car-Fender. Mariano Sparmo, New York, N.Y. Filed July 30, 1895.

552,803. Automatic Electric Alarm. George B. Williams, Texarkana, Tex. Filed April 8, 1895.

552,816. Telephone. Norvil L. Burchell, Washington, D. C. Filed October 29, 1895.

552,823. Telephone System. Frank R. Colvin, New York, N. Y., assignor to the Interior Telephone Company, same place. Filed February 2, 1895.

552,832. Instrument for Treatment of Strictures by Electrolysis. Joseph A. Fort, Paris, France, assignor to the Dr. Fort's Electrolysis Sanatarium, of New York. Filed November 7, 1895.

552,852. Car-Fender. James B. Morrow and Franklin C. Robertson, Oxford, Md. Filed May 15, 1895.

552,858. Electric Motor. George L. Thomas, New York, N. Y., assignor to the Hasell Perfected Railway Signal Company, same place. Filed March 19, 1895.

552,865. Telephony. Frank R. Colvin, New York, N. Y., assignor to the Interior Telephone Company, same place. Filed January 14, 1895.

552,866. Telephone-Switch. George W. Coy, Milford, Conn. Filed April 1, 1895. Renewed December 16, 1895.

552,867. Desk Telephone Apparatus. George W. Coy. Milford, Conn. Filed April 1, 1895.

552,874. Electric-Arc Lamp. William S. Bartholomew, Chicago, Ill. Filed September 23, 1895.

ELECTRICAL AGE

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CONTENTS.

OUR SYMPATHY TO MR. MARTIN.

THE ELECTRICAL AGE extends to Mr. T. C. Martin, editor of *The Electrical Engineer*, its heartfelt sympathy in the death of his father, in England.

PROF. ROUTGEN'S DISCOVERY.

The recent cable announcement of the discovery by Prof. Routgen regarding the photographing of objects through intervening opaque bodies has created great interest in scientific circles. The details of the discovery have not yet been made public and it is yet a little early to discuss the subject on a scientific basis. Scientists in this country are evidently awaiting further evidence before they will commit themselves and consider the subject in the light of the facts as developed by Prof. Routgen. There seems to be an undercurrent of opinion, however, in favor of the alleged discovery, and no doubt many who have the available apparatus are now experimenting along the same line, in order to determine its value.

MACHINE TELEGRAPHY.

We print in this issue the full text of the lecture delivered by Mr. P. B. Delany, before the Franklin Institute, Philadelphia, describing his new system of machine telegraphy. Those who are familiar with telegraphic affairs will see a great deal in Mr. Delany's system to admire and commend, but not all will agree with him as to the applicability of machine telegraphy for general telegraph work. We have no doubt ourselves that an automatic system of telegraphy, when properly handled and managed, would be a gain over the present methods, but it seems an almost impossible task these days to get together and maintain a skilled force on a large scale, even by paying large salaries. As far as the system itself is concerned, Mr. Delany has approached the ideal nearer than anyone else.

ELECTRICITY AT THE CYCLE SHOW.

This week the bicycle interests are in possession of New York, including Madison Square Garden, where the third annual cycle show is being held. A visit to the Garden at any time, day or night, especially night, is sufficient to convince anyone of the popular interest in wheeling. Electricity adds a great deal of splendor and brilliancy to the occasion, and the electric light and electric illuminating devices of every form imaginable give much life to the animated scene. A huge bicycle hangs high up in the air at the Fourth avenue end of the great building, the wheels of which, outlined with electric lamps, are constantly revolving, and at the Madison avenue end there is a large American flag moving electrically in the electrical breeze. The principal use of electricity at the show is in illuminated signs, of which there are many handsome designs. The show would be rather dull without the aid of electricity.

POOR LIGHT ON ELEVATED CARS.

We respectfully suggest to the managers of the elevated railroad in New York the feasibility of adopting electric light on the company's cars. The Brooklyn Bridge cars are successfully lighted by electricity, and we see no reason why the elevated cars cannot be lighted in like manner. Of course it will cost some money to install the system, but the suffering public must have something better than the miserable oil light they are now compelled to put up with. The surface (cable) cars are lighted by gas, and the result is that much of the elevated's patronage prefers them to the dimly lighted elevated cars, although the former are not quite so speedy as the latter. People like light and plenty of it, and we venture to predict that the elevated road will regain much of its lost business if it gives good light in its cars.

A NEW SYSTEM OF MACHINE TELEGRAPHY.*

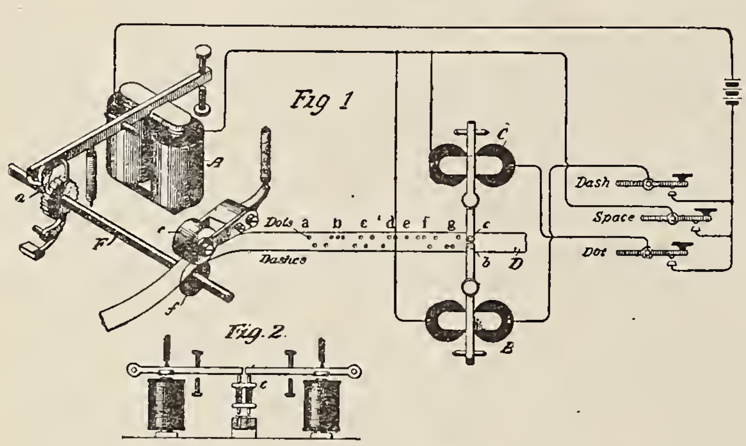
BY PATRICK B. DELANY.

In telegraphy, as in nearly all other industries, there are two ways of working—by hand and by machine. Naturally the hand method comes first. It was so in telegraphy, and it has continued with wonderful tenacity. Even now probably 90 per cent. of the telegraph business of the world is done by hand. In America and England it is by hand and sound. In all other countries, by hand and sight, although Belgium is just beginning to use the sounder. France, Germany, Italy, Austria, Spain, Russia, and, in fact, the rest of the world use the Morse key and a receiving instrument, which records the dots and dashes in ink on a paper tape. There are, however, a number of through circuits operated by the Hughes system. Transmission is by keyboard, and the message is received printed on a tape similar to the tape-printing system of Phelps, which is used in a small way in this country.

England may be said to be the only country using machinery to any considerable extent for the operation of its telegraphs. It employs the Wheatstone system. This is of English origin. Its inventor was knighted for it, and deservedly so, for it is a great system. In its operation, messages are first punched on a tape, which, in effect, becomes a stencil, taking the place of the operator's hand manipulation. This punched strip is passed through a transmitting machine run by weight and clockwork, and, as impulses are sent wherever there is a hole in the paper, the dots and dashes go into the line with perfect uniformity and at great speed.

The receiving instrument records these dots and dashes in ink on a tape, as in the case of hand transmission.

This receiver, however, will record ten times faster than the fastest operator can send by hand; hence the advantage of machine transmission. And again, a machine can be made which will transmit ten times faster than the ink



FIGS. 1 AND 2.

recorder will receive; hence the necessity for a quicker recorder than the inking machine. The Wheatstone receiver comprises clockwork, which pulls the paper tape at a rapid rate; and an electro-magnet, the armature lever of which, at its point, alternates between an ink well and the moving tape, making dots and dashes in response to the impulses coming over the line. The rapidity with which a current coming over a long circuit can be made to move this ink-marking lever determines the speed of the Wheatstone system.

It is claimed that, experimentally, 600 words per minute have been recorded. This would require the armature lever to touch and mark the moving tape 200 times per second.

The practical speed of the system over an ordinary circuit is about 200 words per minute. Apparently, the limit of rapidity of electro-mechanical movement at a distance has been reached, notwithstanding that the impeding effect of self-induction in the electro-magnet itself has been almost completely overcome by the use of the condenser shunt, for there is still the inertia of the moving armature and retardation of the line to be taken into account.

For higher speed at the receiving end of a line *electrolysis* seems to be the only recourse. It is at least ten times quicker than the fastest electro-magnet, which is to be found in the latest Wheatstone receiver.

Alexander Bain was the first to introduce chemical telegraphy. He turned to account Humphry Davy's discovery that by electricity a record could be made on paper saturated with certain chemicals.

Now, while Bain's idea was greatly in advance of the necessities of the time, his apparatus was not equal even

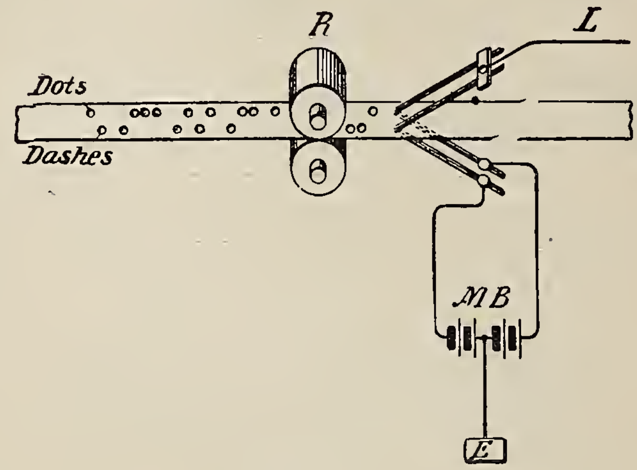


FIG. 3.

to the very limited requirements of forty years ago.

The Wheatstone system, with influence and ability behind it, occupied the field and was improved from time to time, to keep pace with the increasing demands for higher speeds, until five or six years ago, when the limit was reached; nor is it likely that this system can ever be made to do any more than it is now doing.

The chemical system has been beset by many drawbacks. It never had a practical perforating machine. The transmitting instrument was very defective, and in Bain's time the way of overcoming "tailing"—or the running together of the dots and dashes on the receiving tape—caused by retardation of the line, had not been discovered. Consequently, chemical telegraphy in the early days, and even up to about 1870, was a very slow system indeed. It was very unpromising until the discovery, I think, by one of the Varleys, that an electro magnetic shunt around a chemical receiver would, by its opposing current of self-induction, clear out the tailing or shading between signal marks on the chemically saturated tape. Previous to this discovery, when anything like high speeds were attempted, the dots and dashes appeared as a continuous line.

This self-induction, however, has its drawbacks, for the reason that, in order to generate it, a large portion—certainly one-half of the signalling current—must be diverted from the recorder. Furthermore, while it improves the definition, this self-induced current has a tendency to clip or shorten the primary impulses, and, unless properly balanced, will appear as a reversal or negative record between the regular signals on the receiving tape. For these reasons it is best to get along with as little of the self-induction remedy as possible, consistent with legibility of signals.

If electrolysis could be brought about as quickly with small pressure as with greater electromotive force, the speed of transmission could be increased proportionately. The higher the force sent into the line the longer it takes to disappear from the receiving tape. This would suggest the advantage of more sensitive chemical combinations for the paper, but then they might be affected by stray or induced currents from neighboring wires. The present formulæ seem to ignore all but the legitimate impulses coming over the line.

The susceptibility of the receiving tape depends on the speed at which it is running. If the movement is very slow, a very weak impulse will make a distinct mark. If

* Paper read before the Franklin Institute, Philadelphia, November 20, 1895.

the tape is running fast, this plain mark will be drawn out and will be very faint. It is a question of time and current. High speeds require fast-running tape, and the quickly passing chemicals require correspondingly higher electromotive force for dissociation or separation, so that the iron wire may be attacked and corroded, thus causing the mark on the tape. Shortness of application must be made up by increase of pressure.

Another very serious obstacle in the way of chemical, and, in fact, all machine or rapid systems, has been due to the current which discharges towards the sending end of the line after each signal impulse has been sent in. These outcoming currents are proportioned to the charge that creates them. When a dot is sent the line is not fully charged, not as much so as when a dash is sent, therefore

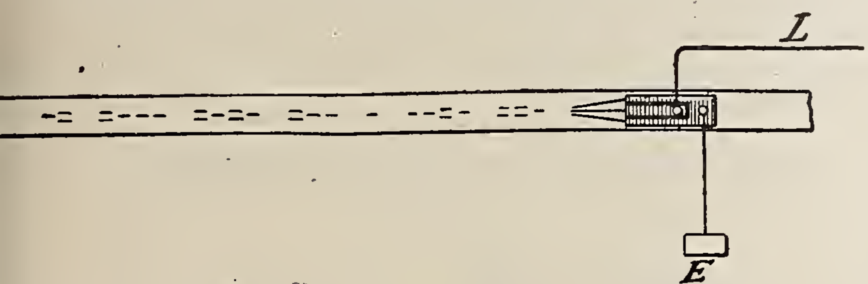


FIG. 4.

the discharge after a dash is much greater than the discharge after a dot. It follows that the discharge from a dash, opposing the passage of a dot, hinders and neutralizes it to a very detrimental degree. The simplest remedy for this trouble is to send no dashes into the line, making all signals of exactly the same duration, and thereby secure uniformity of discharge current as well.

The remaining important defect in machine telegraphy heretofore was in the transmitter.

With the exception of the Wheatstone transmitter, which is entirely too slow for chemical telegraphy, all mechanical transmitters used or proposed have consisted of a revolving wheel over which the perforated tape was drawn. This wheel was connected to the transmitting battery. On top of the tape pressed a scraping finger, which was connected to the line. When a hole in the paper came between the line and the wheel, an impulse was transmitted. Contacts made in this way were very imperfect, and frequently missed altogether, on account of the collection of dirt and dust on the face of the wheel.

Having touched upon the leading obstacles in the way of practical high-speed telegraphy I will now endeavor to explain and demonstrate how, in my opinion, these difficulties can be surmounted; and in doing so I will take up in their order, viz.: the perforator, the transmitter and the receiving machine. You will observe that the improvements about to be described are both mechanical and electrical.

The Perforator.—This machine, as shown in Fig. 1, comprises three keys, dot, dash and space key; two electromagnets for forcing the punches through the tape, and a step by step tape-feeding device, also controlled by an electromagnet.

The operation is as follows: The ribbon is perforated in two lines, the holes in the top line representing dots; those in the lower line dashes. The letters are made of combinations of dots and dashes, preferably according to the Continental Code. The lower contacts of the three keys are connected to one pole of the battery, *L B*. The dot-key lever is connected to the punch magnet, *C*; the dash lever to punch magnet, *B*; and the space lever to space magnet, *A*. Obviously, but one key is pressed down at a time. The spacing magnet is in series with the dot and the dash magnets. To punch the letter *A* the dot-key is pressed down, magnet *C* forces its punch through the paper, and, at the same time, the lever of the space magnet is drawn down, and pawl *a* takes a new tooth in the ratchet wheel on shaft *F*. When the key is released and the circuit broken, the punch is raised out of the die and the strip is drawn a definite length by the saw-tooth wheel *f*, and pressure wheel *e*. Then the dash key is operated in the same way, after which the space key is touched, which provides a space between the letter punched and the one which is to follow. Thus, three times after each word.

Perforating is no more laborious than working an ordinary Morse key, and the speed, with a little practice, will be fully up to the average of Morse transmission.

A side view of the punch magnets, their levers and punches, is shown in Fig. 2.

The Transmitter.—The transmitter, as shown in Fig. 3, consists of a paper-pulling device, represented by roller *R*, and the two pairs of wire brushes pressing toward each other above and below the tape. The top brushes are electrically one and are connected to the line, *L*. The bottom brushes are insulated from each other, one being connected to the positive, the other to the negative pole of the main transmitting battery, *MB*. The battery is connected to earth at its middle.

The paper tape separates the brushes; when a hole in the top line is drawn between the brushes, a positive impulse, representing a dot, is sent into the line. When a hole in the lower line is drawn between the other brushes, a negative current, representing a dash, is sent. In this manner all the dots and dashes on the tape are transmitted.

The brushes are made up of six wires each, so that six contacting points come together at each perforation, rendering failure impossible and insuring perfect uniformity in the quality of the impulses. The ends of the brushes are kept bright and clean by the edges of the holes, and a pressure may be put on them which will insure electrical contact with the tape moving 30 feet per second, or at the rate of 8,000 words per minute, or over 2,500 impulses per second.

In this form of transmitter there are no movable or adjustable parts, no circuit wheels to get dirty, no loose or lubricated contacts. An electric motor is used to pull the perforated tape.

It will be seen that as no dashes are sent, but only dots, which, owing to their position on the tape, *represent* dashes, the impulses are of uniform duration and the line is not more heavily charged at one time than another; and, consequently, the discharge is also uniform; and the signals on the receiving tape are correspondingly regular.

The Chemical Receiver.—The receiver is shown in Fig. 4. It comprises a wheel over which the chemically moistened tape is drawn under three thin iron wires which press lightly on top. The two outside wires are electrically one and are connected to earth. The middle wire is insulated from the others and is connected to line.

When the brushes of the transmitter drop into a hole in the dot line, a positive current is sent and a dot is marked in the track of the middle wire of the receiver. When the transmitter brushes drop into a hole in the lower or dash line of perforations, a negative current is sent and a dot is marked in duplicate on the receiving tape, one in the track of each of the outside wires. This impulse is but a dot in duration; but as it is meant to represent a dash it must have something to distinguish it from the dot signal; therefore the current is forked or divided on the receiving tape, so that all dashes are in the form of double dots,

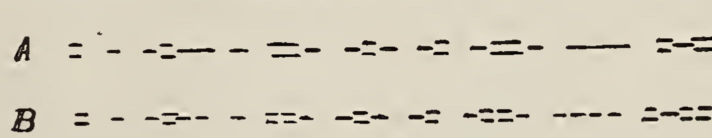


FIG. 5.

while the dots proper are single and occupy the centre line on the tape. It will be understood that the chemically moistened tape forms the circuit between the centre wire and the outer wires of the receiver, or between the line and earth; and that all positive currents come over the line and mark in the track of the middle wire, while negative currents come from the earth and mark in the track of the forked contact, forming double dots, which are recognized as dashes.

In this way, no matter how bad the "tailing" may be, it is impossible to mistake a dot for a dash, or to connect them together erroneously; neither is it necessary to have definition between successive dots or dashes. The length of the composite, single or double mark, determines at once the number of distinctive marks intended. In cable signaling, there is practically no definition as to the number of impulses in the undulations of the ink line. The proportion determines. Of course, in this system of perfectly straight marks in distinctly different lines, translation is much easier.*

The specimens of record, *A* and *B*, seen in Fig. 5, illustrate this most important feature. *B* shows the word "telegraphy" with clearly defined individuality of each dot and dash. *A* shows the same word without any definition whatever, but, notwithstanding, the word to a practiced eye is just as plain in this form as the other. It is safe to say that, with a few weeks' practice, the transcriber would not look for definition in signals.

It will be clear, then, that a length of line, or rate of speed, which would render signals by the ordinary dot-and-dash method utterly illegible, would be perfectly practicable with this method.

Having dealt at considerable length with the technical side of the subject, I must be brief in referring to the commercial possibilities of machine telegraphy.

A perforator will prepare messages as fast as a Morse operator will transmit by hand. The machine transmitter will send, between New York and Philadelphia, over a common iron wire, at least 1,000 words a minute, or as much as can be sent over 50 wires by hand, simplex. If quadruplex is used, 15 wires will be required to compete with the machine system on one wire. With a copper wire of 500 pounds to the mile the machine system will carry 2,000 words per minute, or as much as 30 wires worked quadruplex.

The general introduction of this system for carrying correspondence would require but one or two wires between large cities, and a way wire for smaller places. Any number of towns up to the capacity of the wire could be communicated with in rotation, and messages exchanged. Beginning at one end of the line, each station would clear out with all the other stations and would send to the main distributing and collecting office on the circuit messages for points not on the wire. In this way each office would have what would practically be a half-hourly electrical mail service. Telegraph letters would be perforated as fast as they were handed into the office; so that when the time of each office came around, the entire lot would be ready for transmission.

Two wires would carry all the correspondence now done between New York and Philadelphia; one would accommodate New York, Baltimore and Washington; New York and Boston would require one wire, and one would suffice for way stations. Two through wires would be necessary for New York and Chicago, and so on.

This plan, carried out so as to cover the country, would speedily supplant the present mail service for all correspondence of any urgency, and would take from the present telegraph and telephone companies a great portion of their business, not of sufficient urgency to warrant the comparatively very high charges, when a service equally as good is available at one-tenth of the cost.

Business houses having a large correspondence, and newspapers, would take advantage of the very low rate for simple transmission of dispatches handed in already perforated, and to be delivered on the receiving strip without translation. Such service would probably not cost more than five cents for 100 words between New York and Philadelphia, exclusive of delivery charges, or 10 cents between New York and Chicago. For regular patrons, carrying on extensive correspondence, special arrangements could be made for delivery, or the parties themselves could send to the telegraph office at stated times and receive their dispatches from their box, after the plan of the present post-office system. These means, with the regular post-office delivery, would be the most satisfactory and least expensive for this service, the object being simply to substitute the wire for the railway train for conveying correspondence from one point to another, leaving the collection and delivery to the present very efficient and reliable post-office service. In no other way could very low rates be maintained. There would be no branch offices.

Messages would be sent or mailed to the central station, located close to the general post-office, in each city. Everything addressed to the central station of the company would be dropped in a special drawer, which would be constantly emptied by the telegraph company's collector. In this way a telegraph letter arriving at the general post-office would immediately be taken to the telegraph office, perforated and transmitted to its destination, where it would be dropped in the post-office for delivery, thus practically eliminating the time now consumed in the railway journey.

[* At this point Mr. Delany made several experimental transmissions through an artificial line of 800 ohms resistance, and two microfarads capacity, or the equivalent of an ordinary iron telegraph wire between New York and Philadelphia. Perfectly legible records were obtained at a speed of 1,200, 1,800, and finally 2,400 words per minute, as timed by Mr. Thomas Shaw, M. E., and others.]

PRINCIPLES OF DYNAMO DESIGN.

BY

Newton Harrison E.E.

(*Continued from page 28.*)

Lap and wave winding is generally referred to in connection with multipolar machines; but it can be looked upon as a style generally applicable to drum armatures of all descriptions. The winding can be laid upon the outer periphery of a ring armature or applied to the surfaces of a disk core and in either case prove equally successful. A formula for the determination of the spacing, number of inductors, commutator bars and sections has been applied very successfully by Arnold. A very complete treatise on the subject has been presented by Hobart, and there have been a succession of patents granted to Siemens, Edison, Weston, etc., for different styles of winding. According to the formula as given by Arnold

$$S = \frac{1}{P}\left(\frac{I}{T} \pm a\right)$$

where the values are S = spacing.
P = number of pair of poles.
I = " " inductors.
T = " " turns per section.
a = an arbitrary number.

The additional means employed for finding out the number of inductors limited by these conditions will be

$$I = T(PS \pm a).$$

In the foregoing formulæ the arbitrary value a is such that the number of neutral points is determined by it and also the number of parelled paths for the current.

If the value given to $a = 1$, then the disposal of the circuits will be productive of neutral points, as follows:

number of neutral points $= 2a$.

Thus from a direct application of the above it is possible to consider cases of winding in a systematic manner. Usually, and in fact in all cases, the *spacing* is an odd number in comparison with the number of sections.

Thus, if the value of $S = 7$, the value of the sections must be 6 or 12, or a multiple of the same. But in certain other cases where possibly the value of $S = 21$ and the number of sections = 48, the common factor is 3; there are then an equal number of distinct circuits, namely, *three*. The further circumstances to be considered are the two previously mentioned styles of winding and the value which the characters in the above formulæ assume when each is utilized.

Lap Winding.—With this form of winding the values are which are wound $\left\{\begin{array}{l} P = 1 \\ a = 1 \end{array}\right\}$ for those inductors between two like poles.

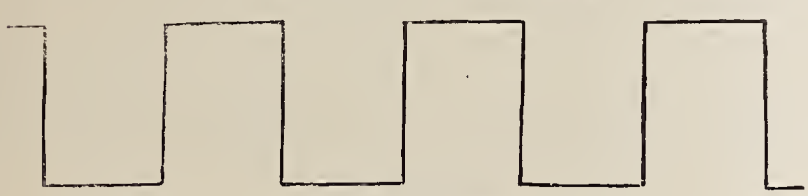
As an illustration of the general application of the last methods take a machine in which the number of inductors, etc., are given as follows and calculate the spacing—

	I	number of inductors	= 144
	P	" " pair of poles	= 1
	T active	" " wires per section	= 2
(note)	n	" " sections	= 72

$$S = \frac{1}{P}\left(\frac{I}{T} \pm a\right) \quad \text{(Rule)}$$

$$= \frac{1}{1}\left(\frac{144}{2} \pm 1\right)$$

$$= 73 \text{ or } 71 \text{ for spacing,}$$



WAVE WINDING.

which would undoubtedly bring the section wound after any other either on one side or the other of the last one wound.

The second formula determines the number of inductors allowable with the turns per section, pairs of poles, and spacing, known—

T	number of active wires per section	= 4
P	" " pairs of poles	= 1
S	spacing	= 69

(Rule) $I = T(P\,S \pm a)$

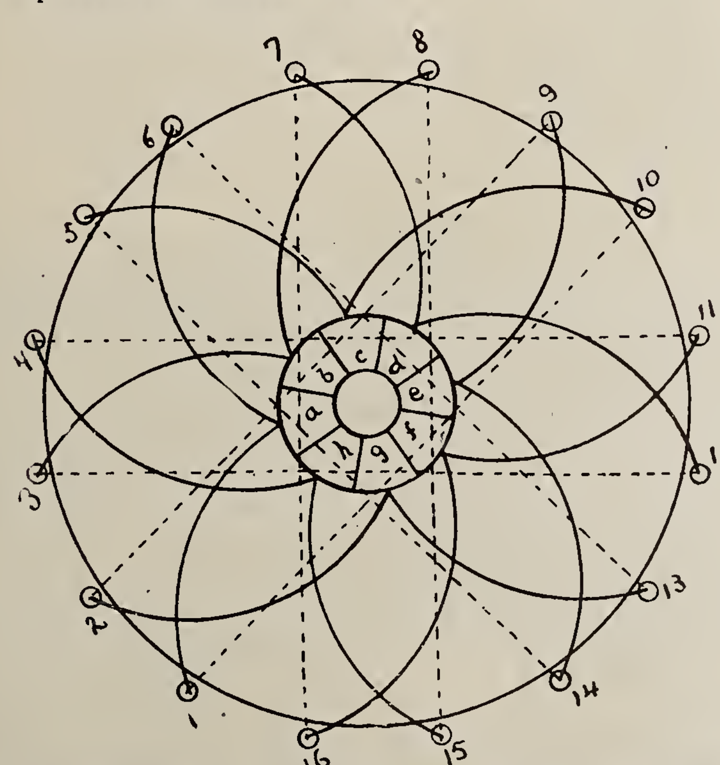
$= 4\,(1 \times 69 \pm 1)$

$= 280$ or 272,

thus clearly showing the numerical difference between the spacing and the sections—the spacing always being a prime number with respect to the sections :

i. e.	1st example,	sections 72	spacing 71 or 73
	2d "	" 70	" 69 or 71

With the next form of winding there is another relation to be preserved between a and P.



DRUM ARMATURE WITH EVEN NUMBER OF TURNS AND SECTIONS.

Wave Winding.—In this case the current divides somewhat differently from that in the preceding case.

The number of circuits in parallel are equal to the number of *pairs* of poles. These feed into the brushes for purposes of distribution. Yet there are as many divisions to the current as there are poles, though by means of the winding they are directed into a circuit whose pressure is in series with its own. For instance, a four-pole or six-pole machine would have four or six multiple circuits, which by means of lap winding remain in multiple and by the use of wave winding are thrown into fewer parallel circuits.

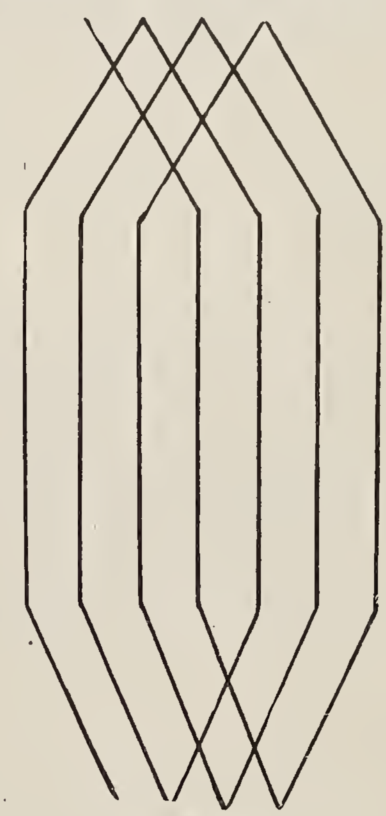
The value given to a with wave winding depends upon the number of pairs of poles. Therefore the practice calls for $a = P$, thus giving in a four-pole, six-pole or eight-pole machine the successive values for a, as follows :

$a = 2$—for the number of circuits thrown into multiple by
$a = 3$ this arrangement.
$a = 4$

A pure series grouping has but *two* parellel circuits, as though there were but two poles affecting the inductors. In this winding the arbitrary number $a = 1$.

The development of a winding will lay bare the paths for the current in a very obvious manner, and illustrate the necessity for each special type of winding for any desired advantages.

Lap.—The names are simply due to the general similarity existing between the windings and their specified



LAP WINDING.

simile, the lap being a form of winding in which after each advance there is a retrogression. The amount of this return depends upon the spacing and gives it an appearance which is as illustrated.

The development of multipolar dynamos brought winding down to a more systematic basis than before and utilized loop winding for armatures that are multiple wound.

Wave.—For series winding the wave form came into prominence, and took its name from the peculiar back and forth movement of the wire, which in diagram represents it as a sinuous line of wave form as represented in the sketch.

In all cases this style of winding is adopted where a high pressure is desired ; and it is possible by the development of it on a plane to see the points of + and — sign from which commutation occurs.

(*To be continued.*)

UNDERGROUND WIRES IN ST. LOUIS.

The Board of Improvements, St. Louis, Mo., has adopted the draft of a proposed ordinance providing for the placing of overhead wires in the city underground after January 1, 1900. After that date the city shall have the right to cut down all poles and overhead wires, and the proposed ordinance provides a penalty against persons maintaining the same.

DEPARTMENT OF ELEMENTARY EDUCATION.

BY THE EDITOR.

[*Note.—Any one is invited to ask questions on any point that is not made clear in these articles. Suitable explanations will be cheerfully given under the head of " Answers to Inquiries."*]

ELECTRIC BELL CIRCUITS—CONTINUED.

(*Continued from Page* 31.)

A return-call circuit, using only two wires, is shown in Fig. 7. In place of the push-button a double contact key is used, and a battery is provided at each end of the line.

A double contact key is simply a strap of spring brass secured at one end to a wooden support, while the other end plays between two contact points, one above and one below, as shown in Fig. 8. One of the wires is connected to the back end of the strap, which becomes a part of the circuit. The natural spring of the brass keeps it in contact with the upper point, and when we depress the strap it makes connection with the lower point. By tracing the connections in Fig. 7 the use of this key will be readily understood.

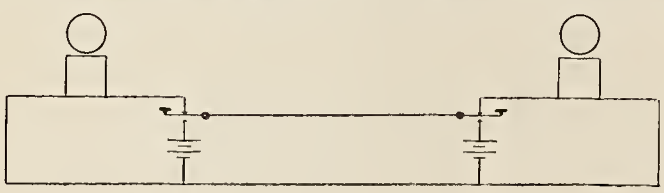


FIG. 7.

A further saving of wire can be effected by running the circuits as shown in Fig. 9, where only one wire is called for between the two ends, the earth being again called into requisition for the sake of economy.

In Fig. 10 we have a circuit of two wires, in which both the home bell and the distant bell ring when the home or distant push-button is closed. It requires a battery at both ends of the circuit to accomplish this result.

Fig. 11 is a similar circuit, using the ground as the return

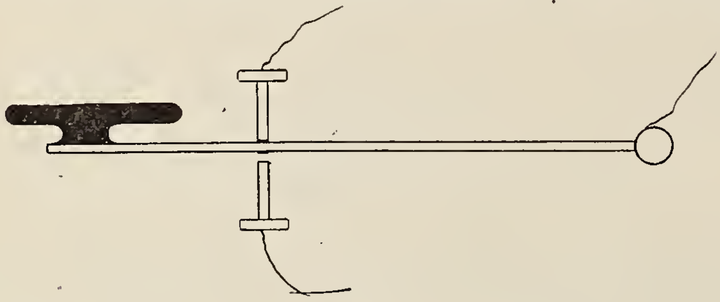


FIG. 8.

wire. In this case as in the one above, either push-button rings both bells at once, there being a battery at each end.

It is not claimed that the diagrams given cover every possible requirement in electric bell circuits, but they contain suggestions and elements which are capable of a great variety of combinations, and it is safe to say that any

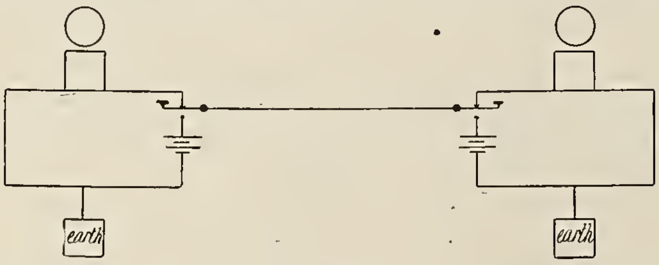


FIG. 9.

special circuit can be designed using one or more of the examples given as bases.

We next come to the subject of

BURGLAR ALARMS.

The name burglar alarm has to many people a more alarming sound than the thing itself justifies. A burglar alarm is, of course, essentially an alarm that will ring when a window or door is forcibly entered, but the word is somewhat elastic and is sometimes applied to apparatus and circuits that are used for other purposes as well. We shall, however, for our purpose adhere to the strict sense of the word and describe the apparatus used in the protection of our homes, stores, etc., against unlawful entrance.

A burglar alarm is a silent watch-dog, and a burglar would rather deal with a dog because he knows he can silence the animal; but not so with a burglar alarm. Often he can't tell whether his unlawful work is causing a distant burglar alarm to ring or not, so he must always be in doubt on that point and take the chances.

The most important requirement of a burglar alarm circuit is to keep it in working order. Strange things happen

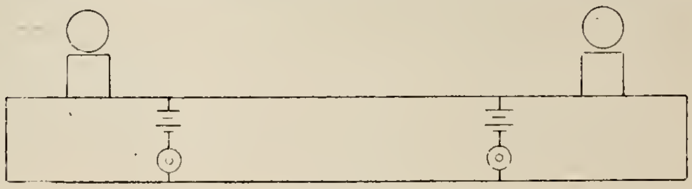


FIG. 10

in this world, and it has come to pass on many occasions that burglars have entered houses and stores at the very time when the burglar alarm was out of order. We do not believe that in many, if any, of the cases the thieves *knew* that the alarm was out of order; but somehow disarranged burglar alarms and thieves seem to have an affection for each other, and where one is the other is liable to be.

The next requirement of importance is to conceal the wires and apparatus as much as possible, so as to leave the unwelcome visitor in as much doubt as you can concerning the existence of a burglar alarm about the premises. If he feels sure that there is none he will not falter in his purpose; but if he suspects that there is an electric alarm set against him, the suspicion may entirely change his intentions before he actually begins his work. Therefore it is of the greatest importance that the burglar alarm shall be kept in working order, and that the wires, etc., are concealed from view.

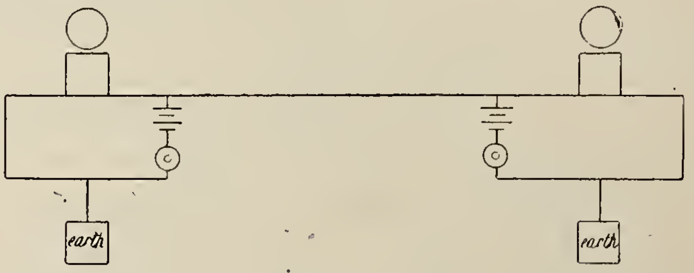


FIG. 11.

Burglar alarms in general are designed to ring an alarm when a thief or burglar tries to get in through a window or a door. They are also used for other special purposes, such as the protection of bank vaults, etc.

Burglar alarm circuits do not differ much from those already shown under the head of Electric Bells—that is, as far as the running of wires, the connections, battery, etc., are concerned. They require, however, some additional apparatus, such as one or more switches, an annunciator or indicator, and window and door-pushes.

The switch (see illustration Fig. 12) is used for the purpose of disconnecting the annunciator so the bell will not ring in the daytime, and to connect it at night just before retiring.

The switch, indicator and battery should be placed in the chamber of the head of the house. Just before retiring all he has to do is to turn the switch on and the thing is ready for Mr. Burglar.

The writer was once acquainted with a gentleman who kept his family on nettles all the time for fear they would do something and set off the alarm. He had his front gate connected, his front door, the steps leading to the front door and the steps to the first floor. We are not sure that the wicked glance of a burglar would not have set the thing agoing.

Corrections.—Two errors crept into our article of last week, and they were chargeable to the draughtsman in both cases. In Fig. 2 (page 30), the battery was placed on the wrong side of the extra push-button. It should have been located at the left of the added push-button. As shown in the diagram there would be no current to ring the bell when the extra push is closed; but by placing the battery between it and the bell it is evident that either push-button will ring the bell.

It will be appropriate at this time to state that in all bell circuits of this class the battery should be located between the bell and the push-button *nearest* to it.

The other error occurred in the second column of the same page, where it reads: "Some people want electric bells and push-buttons all over the house, so that they can, from any part of the house call the servant, wherever *she* may be. Fig. 5 shows a circuit with three push-buttons and three bells, all bells being rung by any one push-button."

The Fig. 5 intended for this reference was omitted by mistake. The illustration designated as Fig. 5 comes in

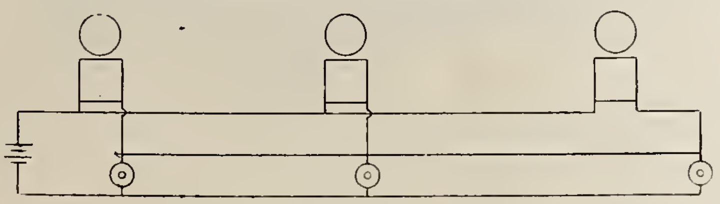


FIG. 5A.

all right further on in the same article. To make the article straight, the paragraph quoted above may be regarded as not printed at all; then the reading matter and illustrations will fit each other all right.

The missing Fig. 5 (which we will now designate as 5a, in order to avoid confusion) is given herewith. Apply it to the paragraph in question and everything will be straight. —The Editor.

ANSWERS TO INQUIRIES.

[*Note.—This column is open to any of our readers who desire special information on any subject. In case we cannot give the desired information ourselves the inquiry will be published, in order to elicit a reply from some one of our readers. These answers will be published in due course.*

The full names of our correspondents will not be published, but for the purpose of identification their initials or other mark of identity will be substituted therefor.

Each question will be numbered for the purpose of ready reference.

All are invited to make free and liberal use of this column.]

14.—In your diagrams of bell circuits you use several parallel lines to represent the battery. Why do you use lines for that purpose? R. M., New York City.

A.—That method of representing a battery is generally used in diagrammatic work. You will notice in these and all other diagrams of like character that there is always an even number of such lines, and that one short line always succeeds or precedes a long one. Each cell of battery is represented by two lines—one short and one long. The short line represents the zinc element and the longer line the carbon element. The carbon element is represented by the longer line because it has a larger surface than the zinc element, which is represented by the short line. This method, therefore, enables the eye to distinguish one pole or element from the other.

15.—What are Crooke's tubes? You refer to them in an article in The Electrical Age of January 11, about photographing objects through boards, etc., by the use of these tubes. H. W. J., Long Island City, N. Y.

A.—Crooke's tubes are glass cylinders sealed at both ends with the air exhausted from the inside. The vacuum they contain is very high, the air left being only about one-millionth part of its ordinary density. These tubes are used for the purpose of showing the phenomena of the ultra-gaseous state of matter and important electric principles. When the interior space of one of these tubes is charged with static electricity, the walls of the tube become beautifully phosphorescent.

16.—What is the best material to use for lightning rods and what is the cause of thunder? T. S., Richmond, Va.

A.—Copper. Thunder is supposed to be caused by sudden heating, expansion and compression of the air by the lightning spark. If the spark is straight and short but one short clap of thunder will be heard; if its path be a long one and crooked, successive sounds one after the other will be heard, having a "rattle," and the echoes from other clouds will come rolling in afterwards.

17.—What is the difference between earth currents and those caused by the aurora? T. E. F., Mauch Chunk, Pa.

A.—There is no difference; they are both electric currents and both have the same effect. Telegraph circuits, of which the ground or earth forms a part, are seriously affected sometimes by these currents, and when they prevail all efforts to transmit dispatches must be practically abandoned. It is sometimes possible on these occasions to transmit dispatches by utilizing the earth currents instead of the current from the regular source, but these currents are very unsteady and unreliable.

18.—Is there a perfect vacuum in the bulb of an incandescent lamp? I. T. A., Dunkirk, N. Y.

A.—No; it is practically impossible to produce a perfect vacuum in a lamp bulb. The quantity of air remaining, however, is infinitesimal as compared with the original volume.

19.—Does a stroke of lightning always occur from the clouds to earth? S., Nyack, N. Y.

A.—Not always. Sometimes the electric discharge takes place from earth upwards; this kind of discharge is called the "return stroke."

20.—Will you please inform me what is the best battery to use for electro-plating, and what are the essential requirements of a battery to be used for such work? B. S. W., Eureka, Nev.

A.—The Bunsen cell gives the best results. It produces a strong, full current. The essential requirements of an electro-plating battery are: 1, constancy; 2, low internal resistance; 3, high electromotive force; 4, large current.

ELECTRICITY FROM THE SUN.

Of all the unfathomable secrets of this world there is one at least distinct from all others that excites wonder and surprise in all that hear of it.

The ponderous orb of the sun, millions of miles away, is fettered to us by chains that are mighty in their unmeasurable strength but sensitive as a butterfly's wing to the touch of a disturbing hand.

It is this vast planet, in its throes of inward convulsion, that sends out waves of billowy disturbances—of mute signs and silent quiverings.

When the cyclones that stir up the solar photosphere and cause deep vortices to form are at their worst the earth passively responds to these fearful outbursts and is swept from pole to pole by a maelstrom of electricity. The magnetic needles of the earth swing erratically, and the secondary phenomena with the glorious aurora of the north absorb the thoughtful and contemplative mind.

Newton Harrison.

NEW WATER-WHEELS FOR ROCK ISLAND, ILL.

The People's Power Company, Rock Island, Ill., has closed a contract for water-wheels with the Trump Manufacturing Company, Springfield, Ohio. Twelve new wheels are called for, and these with a seven-foot head of water will generate 2,000 horse-power. Six of the wheels will be delivered at the plant about June 1, next. It is stated that the Trump Company got the award because their model showed the greatest percentage of efficiency, according to the Holyoke test, and the ease with which the gates are operated.

The power from the new plant will be utilized in operating the cars on the Moline Central Street Railway Company, which is said to be the longest street railway in the country operated primarily by water-power.

THE GORDON BATTERY.

This battery, although a comparatively new comer, is rapidly extending in use, and is evidently very much in favor.

The accompanying illustration gives a general idea of the construction of the battery. The cell is entirely different to all others in its make-up, and is said to be superior to any other for closed and open circuit work. The elements are copper and zinc.

The main features of the Gordon cell are its long life, efficiency, economy, adaptability, freedom from local action, gases and odors, and non-freezing.

This battery is now extensively used in railroad signalling, fire alarms, telegraphy, police and watchman signals, automatic fire alarms, burglar alarms, telephony, etc., etc.,

GORDON BATTERY.

and it commends itself for all purposes on account of its long life and economy. It requires no attention whatever during its life, which is guaranteed, for ordinary railroad signal work, to be six months. It then requires a new charge and it is good for another six months.

Fifty of these cells have been doing remarkable work at the Mott Haven station of the New York Central Railroad, where there are many track instruments and other railroad signals to operate. These cells have now been in use several months without a break or interruption of any kind. The most remarkable performance of the Gordon cells have been upon the track circuit. They have done that work in very wet weather, when the tracks were nearly under water in several sections of the blocks they were operating, and even while exposed to the weather at a temperature at times 8° below zero, for many days they continued to operate the relay in a satisfactory manner, and they are in good order yet. At present they are in service upon another circuit and doing good work, although there has never been any renewals whatever of their elements.

In regard to the life of the battery it is warranted to operate, at a discharge rate of eight or ten one-hundredths of an ampere, six months without any attention whatever, as required for railway signal service, and much longer where less power is required.

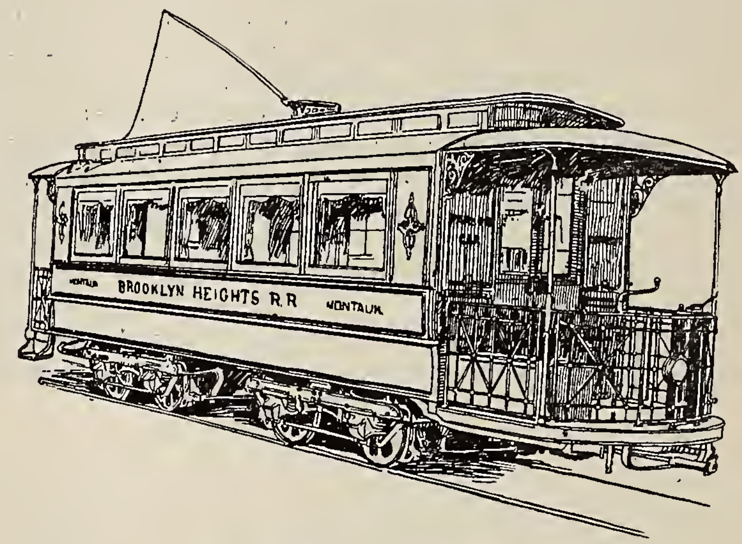
As to economy, the installations and maintenance of the Gordon battery for one year for railway signal service is about one-half the cost of the gravity battery. In practical operation in railway signal service, the Gordon battery on the surface of the ground has worked uninterruptedly with the mercury 4° below zero.

There is no consumption of material when the battery is not in use, and the freedom from noxious vapors and creeping salts adds much to its desirability.

The Gordon-Burnham Battery Co., 82 West Broadway, New York, are the manufacturers of this excellent battery.

THEATRE CARS IN BROOKLYN.

On Saturday last the officials of the Brooklyn Heights Railroad Company gave an excursion to a party of press representatives and other distinguished persons on the company's two new theatre cars. These elegant cars are fitted up after the style of Wagner palace cars, and are named "Amphion" and "Montauk"—after Brooklyn's



BROOKLYN THEATRE CAR.

finest theatres. During the trip luncheon was served on board the cars. The cars are fitted out in the most elegant manner, and run with remarkable smoothness. The windows are of plate glass and draped with rich curtains. There are four tables in each car on which luncheon may be served. Each car has a seating capacity of 20 persons, and it is the company's purpose in adding these elegant vehicles to its rolling-stock to charter them to skating and theatre parties in the winter months, and pleasure parties during the summer months.

Electric bells and push-buttons are provided in abundance to summon attendants. The cars are heated and lighted by electricity and the floors are carpeted. They were built by the Barney Smith Company, of Dayton, Ohio.

T. S. Williams, secretary and treasurer of the company, took charge of the party and made their excursion as pleasant as possible.

MUNICIPAL LIGHTING.

The proposition of the Edison Company, of Topeka, Kansas, in regard to street lighting was rejected by the City Council. Councilman Drew figured out that the city could operate its own plant several thousand dollars cheaper than the price asked by the Edison Company.

The Council of Colusa, Cal., is considering the subject of establishing a municipal plant, and in Portland, Oregon, the *Oregonian* is advocating the same idea.

The special committee appointed by the councils of Reading, Pa., to consider the advisability of the city owning an electric light plant, has submitted a favorable report. The committee states that for $60,000 a plant can be erected sufficient for the city's needs, and recommends the erection of such a plant.

BY LONG DISTANCE TELEPHONE TO HENDERSON.

Henderson, Ky., on January 16 became connected with the outer world by long distance telephone. The American Telephone and Telegraph Company and the Cumberland Telephone and Telegraph Company opened the Henderson connection on the date named.

Personal.—Mr. E. G. Bernard, of Troy, N. Y., was in town this week.

QUEER THINGS PATENTED.

The New York *Sun* recently printed an article on the queer inventions that have gone through the patent office.

Perhaps one of the most amusing patents ever granted was issued on the claim of an Ohio man in 1883. He evidently had not lived a great length of time on a farm, for his invention of a new corn planter, while original to an extreme degree, could hardly be put into use. The picture accompanying the patent is a work of art. It represents an old horse driven by a stout man, who holds the lines nonchalantly in one hand, an expression of much pleasure on his face, while at his side trudges a small, hairy dog of the yellow variety. To the horse's forelegs, just above the fetlocks, are attached two small boxes to contain the feed. Ropes are fastened to catches in the sides of these boxes and lead through pulleys attached to a small saddle over the horse's shoulder and back to the horse's hind legs. As the horse moved forward each step of the hind leg opened the seed boxes, and corn was sifted down into the holes made by the front hoofs. The verbiage of the claim on this patent is as original as is the drawing:

First. I claim the combination substantially set forth with the cheap old horse, A, to the forelegs of which are attached the boxes, B B, that are to be filled with corn.

2. I claim the pulleys, C C, in combination with the strings, D D, substantially as shown in the drawing.

3. I claim the guide, E [a small iron affair shaped like a rowlock, fastened above the horse's tail, through which the lines pass], for the purpose set forth, and the sticker, H, to prevent the lowering of the tail.

4. I claim the fat driver, F, to prevent the said cheap horse from going too fast.

5. I claim the fat dog, G, merely as company for the driver.

6. I claim the worms (not shown) in combination with the crows, K K, substantially as shown in the drawing for the purpose set forth [a purpose not set forth].

A man not long ago invented a balloon attached to a trolley wire. This balloon was presumably for purposes of long distance investigations by telescope in time of war. Underneath the trolley wire was a motor which operated two large wooden propellers sending the car along and pulling the balloon. Another man invented a "steam nigger," operated by an electric motor in the regions of the pit of the stomach. The invention's use is not set forth. S. S. Applegate invented an arrangement for waking himself up early in the morning. A series of corks dangled above the place his head ought to be in a bed, and actuated by clockwork, made life a burden for the weary sleeper, until in self-defence he was obliged to get up. Another invention of the same kind was a contrivance for dumping the hired girl out of bed at 5 A. M This, too, was actuated by clockwork. It was not considered to be so polite or gentle a method as that of Mr. Applegate's. There was another invention intended to save the weary Benedict a few hours of slumber in the morning, for a mechanism placed under the kitchen fire was supposed to light it at any hour desired. There is a very funny model at the patent office of a cat made of sheet-iron operated by clockwork. It is intended to be placed on the roof of a house, woodshed or back wall in neighborhoods where the night is made hideous by nervous Thomases and Marias. At any touch or warlike demonstration on the part of its curious neighbors the clockwork sets the claws going all at once at a tremendous rate, and there is a temporary rest for the weary.

SUFFOCATED.

Harry Pontet, electrician at George W. Vanderbilt's mansion at Asheville, N. C., was suffocated in a gasoline tank on January 18. He had gone into the tank to make an examination, and was overcome by the fumes. He was a native of Switzerland.

GOOD EDUCATIONAL WORK.

The eleventh anniversary of the Young Men's Institute of the Young Men's Christian Association was celebrated in the Institute Hall, 222 Bowery, New York, Tuesday evening, January 14.

The secretary's report showed that during the year over 1,000 young men have received benefits as members of the Institute, either in the gymnasium or in the evening educational classes. The commercial branches are taught, also steam engineering, practical electricity, carriage drafting, mechanical, architectural and free-hand drawing, vocal music and other subjects.

Forty-five lectures and concerts have been given in the Hall during the year.

Any young man over 17 and under 35 years of age, on payment of a fee of $4.00, is entitled to the privileges of the Institute for one year. Report can be had of Dr. D. E. Yarnell, 222 Bowery.

NORTHWESTERN ELECTRICAL ASSOCIATION.

This association held its fourth annual convention at the Hotel Pfister, Milwaukee, on January 15, 16 and 17. The election of officers for the ensuing year resulted as follows: President, Pliny Norcross, Janesville, Wis.; first vice-president, Chas. D. Wyman, Milwaukee; second vice-president, H. C. Higgins, Marinette; secretary, Thos. P. Mercein, Milwaukee; treasurer, John Schuette, Manitowoc. Mr. Mercein takes the place of Mr. Wm. Goltz, who is now abroad. Papers were read by W. J. Buckley on "Modern Apparatus and Existing Conditions," and by Fred DeLand on the "Upbuilding of a Small Town." On the second day the session was taken up with the reading of papers, the most interesting being entitled "Some Facts About Acetylene Gas," by J C. McMynn, and also a paper by E. R. Cunningham, entitled "Power Transmission Plants." A telegram was received from Mr. Pliny Norcross, who had been elected president of the association, in which he declined to accept the office. In the evening the association held its annual banquet, about one hundred people being present. After the dinner was over a number of very lively and interesting speeches were made, amongst those who spoke being Thos. R. Mercein, H. G. Underwood, Geo. Cutter, R. C. Spencer, C. D. Wyman, F. De Land, John Schuette, Jas. Wolff, E. H. Bottum, I. P. Lord. At the third session the matter of electing a president to take the place of Mr. Pliny Norcross was taken up and Mr. W. B. Baker, Waupaca, Wis., was chosen.

MAGNETIC FIELD.

An air space filled with lines of magnetic force is called a magnetic field. A magnetic field cannot exist without an inducing magnet or current of electricity. The space surrounding and in front of the poles form the field As is well known, lines of attraction radiate from every part of the pole. These are most numerous in front of the pole, although they spread out in all directions. That part of the field in which the lines are most numerous attracts a piece of iron most strongly, and is said to be the most intense part. The greater the number of lines of force in a given space the stronger or more intense the field. If the magnet be bent, so as to bring its poles close together, the lines of force can be shown to have become concentrated.

DEATH OF J. W. DUXBURY.

John W. Duxbury, superintendent of the Central division of the New England Telegraph and Telephone Company, died at Lowell, Mass., January 14, aged 51. He was an old-time telegrapher, and was for many years a sub-chief in the Boston office of the Western Union Telegraph Company.

MUNICIPAL LIGHT IN TOMAHAWK.

Tomahawk, Wis., has yielded to the seductive influences of the electric light idea.

NEW TELEPHONE COMPANIES.

Georgetown, S. C.—Mouzon & Turbeville are organizing a telephone company.

Norfolk, Va.—A bill to incorporate the Tidewater Telephone Co. has been introduced in the legislature. The incorporators are: T. C. Sykes, J. F. Newberne, L R. Hyslop, J. T. Loring, N. M. Salphine, A H. Martin, H.W. West, O. E. Smith, W. E. Ferrebee and W. Sharp, to construct and maintain telephones. Capital stock to be not less than $5,000 nor more than $150,000.

Decorra, Ill.—Articles of incorporation have been applied for to establish telephone communications throughout Henderson County. Incorporators: Hon. J. O. Anderson, of Decorra; O. L. Dunsworth, E. H. Allison, E. B. Campbell, J. M. Loomis and J. F. Mains of Stronghurst. The capital stock is $2,500.

Oxford, Pa.—The Octoraro Telephone & Telegraph Co. has been granted a charter. The purpose of the corporation is to construct and maintain a telegraph and telephone line through the counties of Chester, Lancaster and York, running principally along the tracks of the Lancaster, Oxford and Southern Road. The capital is $5,000 and the directors are, president, S. Ralston Dickey of Oxford; vice-president, E. L. McSparran of Goshen; secretary and treasurer, Eli McKissick of Oxford.

Canton, O.—A new telephone company has been organized by local capitalists. President, Edward S. Raff; Charles R. Miller, secretary of the Board of Trade, vice-president, and Albert Hoeffer, a manufacturer, secretary and treasurer.

Telephone Notes.

Hopkinsville, Ky.—Hopkinsville is to be connected with Fairview by telephone.

Marengo, Ia.—A telephone line is projected from Marengo to Belle Plaine.

Kewanee, Ill.—At the regular meeting of the town board a franchise was granted to Rathborn & Brown, of the People's Telephone Co., to put up and operate a telephone line between Kewanee and Calva and between Kewanee and Cambridge.

Owensboro, Ky.—The Owensboro telephone line is soon to be extended to Louisville, via Cloverport.

Medina, N. Y.—Efforts are being made here to introduce the automatic telephone with good prospects of success. If there seems to be a demand for a new exchange a company will be formed to put in the lines, using the automatic central office switches.

Henderson, Ky.—Henderson is to have another telephone company.

Delphos, O.—It is understood that a new telephone line is to be constructed between Delphos and Findlay, to pass through Beaver Dam and Bluffton. The line belongs to the system controlled by George W. Beers of Fort Wayne, Ind.

The new heavy copper metallic circuit of the Montreal & Toronto telephone line is now open for business. The time unit per conversation is three minutes, and the rate from London, Ont., to Montreal, Que., is $2.60, and 20 cents for each extra minute. Half rates of above between 7 p. m. and 6 a. m. The rate from Toronto to Montreal is $2 for three minutes and $1 from Toronto or Montreal to Kingston.

An attempt is being made at Ottawa, Ont., to organize a private telephone service in opposition to the Bell Telephone Company.

TELEPHONE PATENTS ISSUED JANUARY 14, 1896.

Telephonic Apparatus. Carl J. Schwarze, Adrian, Mich. (No. 552,972.)

Telephone Circuit. Edward Slade, Newton, and John S. Stone, Boston, Mass. (No. 553,179.)

New Corporations.

Glenville, Conn.—The Port Chester & Glenville Tramway Company has been organized with David J. Pearsall, president; W. G. Bushnell, treasurer; R. Jay Walsh, secretary; to build an electric railway at a cost of $75,000.

Latrobe, Pa.—The Latrobe & Ligonier Electric Street Railway Company has been incorporated, with Edward E. Robbins, of Greensburg, president; to build an electric road from Loyal Hanna Creek, through the township of Unity, and the boroughs of Youngstown and Ligonier. Capital stock, $72,000.

Trenton, N. J.—The Citizens Electric Light Company was incorporated with $100,000 capital stock. Incorporators, P. J. Berry, Edward A. Fisher, George Hildebrecht and John M. Burgner.

Washington, D. C.—A bill to incorporate the Columbia Company has been introduced in congress. J. W. Chalfant, J. N. Pew, W. T. Marshall and others of Allegheny county, Pennsylvania, are the incorporators. Capital stock, $100,000. To erect electric light and power plants, etc.

Cleveland, O.—The Degnon Construction Company has been incorporated by M. J. Degnon, E. W. Radder, W. P. Johnson and Wm. H. Miller, to build electric railways, erect buildings, etc. Capital stock, $200,000.

Philadelphia, Pa.—Alpine Manufacturing Company has been incorporated by Charles D. Cuzner, Charles J. Fox, John G. Patton, Wm. T. Rice, to manufacture electrical appliances, etc, Capital stock, $100,000.

Charleston, W. Va.—The Charleston Electric Railway and Power Company has been incorporated by Neil Robinson and E. S. Buttrick. Capital stock, $500,000.

Montgomery, Ala.—The Montgomery Street Railway Company has been formed. Capital, $100,000. The West End Electric line has been secured and will be improved and extended. A. Troy and G. B. Shellhorn are interested.

Amherst, Mass.—The Amherst & Sunderland Electric Railway Company has been incorporated with T. L. Paige, president; David Barry, secretary and treasurer, to build an electric line to cost $75,000.

Aylmer, Que.—The Deschenes Electric Company has been incorporated to build and operate works for the distribution of electricity. R. H. and John C. Conroy are among the promoters.

Possible Contracts.

Southington, Conn.—An appropriation of $30,000 was voted for the erection of a new high school building.

New York City.—The Harlem Casino Co. will erect a two-story extension to the Harlem Casino, in 124th street east of 7th avenue. When the addition is completed a roof garden will be built covering the old and new structures, and will be 100x150 feet in size.

YOUNGSTOWN, OHIO.—The Park and Falls Street Railway Co. will construct its power house in this city.

NEW BRITAIN, CONN.—The New Britain Electric Railway will at once push the work of building its extension to Newington.

HYANNIS, MASS.—The Hyannis Yacht Club is to erect a $5,000 club house, from plans by Howard & Austin. Brockton. The building is expected to be ready by June 1.

BARRE, VT.—At a meeting of the incorporators of the electric road the agreement made between the committee and the Burlington parties was submitted and approved. Directors, F. G. Howland, D. M. Miles, H. K. Bush, J. S. Pierson, J. J. Flynn and F. C. Kennedy, of Burlington.

AKRON, O.—Col. George T. Perkins, president of the Second National Bank, this city, is to erect a handsome building for the Mary Day Nursery Association. The structure will be complete in every detail. A Cleveland architect is in the city making specifications for the building.

CONSHOHOCKEN, PA.—The Schuylkill Valley Traction Co. intends to extend their Conshohocken road from that town to Bryn Mawr.

CHARLEVOIX, MICH.—Charlevoix Electric Light Co., Chas. Gabriel, manager, has been granted a franchise to construct a $30,000 electric railway.

ORANGE, N. J.—Plans are out for a new building for the Young Men's Catholic Lyceum of Orange valley. They are drawn by Augustus Eichhorn. The estimated cost of the building is $20,000.

PHILADELPHIA, PA.—Common Council has returned the bill to Select Council with the electric light appropriation at $800,000, which was to include the construction of a city electric light plant.

An ordinance was introduced by Mr. Rose for the erection of a municipal electric light plant, and appropriating $250,000 for the same.

DETROIT, MICH.—Joseph G. Kastler, 1015 Chamber of Commerce Building, has prepared plans for a three-story brick and stone school-house, to be erected for St. Anthony's Roman Catholic Society, corner Field and Gratiot avenues, to cost $25,000.

SPRINGWELLS, MICH.—Chas. A. Parkin and others have been granted a franchise to construct an electric railway on the Wyandotte road.

WATERTOWN, MASS.—The Newtonville and Watertown Street Railway Co. have applied for franchise for electric line between Watertown and Brighton.

SHELBURNE FALLS, MASS.—Herbert Newell is interested in the construction of an electric railway between Buckland, Shelburne Falls, Shattuckville and Colerain, which recently secured right of way for same.

PORT HURON, MICH.—A line between Detroit and Port Huron is the latest probability of the trolley business in this section of the country. George A. Parker of Marine City is one of the chief pushers in the new movement.

ATLANTA, GA.—Plans are now being made by Bruce & Morgan for a twelve-story office building, to be erected by W. W. Austin. The building will have electric lights, etc. Bids will be wanted in a few days.

JACKSON, MICH.—A bill to authorize the erection of a new $1,000,000 capitol building has been introduced in the legislature. Address the governor.

SCRANTON, PA.—The stockholders of the Board of Trade Building have authorized the directors to expend $185,000, instead of $150,000, as was first contemplated, in erecting the proposed building on Linden street.

HOBOKEN, N. J.—The new $60,000 public library building will have electric lights, and bids are now being asked for electric wiring for the same. Thos. F. Hatfield, librarian, may be addressed for particulars.

BOSTON, MASS.—The gas and electric light commissioners issued an order approving an issue of the Boston Electric Light Co. of $200,000 mortgage bonds, and the proceeds thereof, to be applied in payment of the cost of additions and extensions of the company's plant made since the first of July, 1895.

NEWARK, N. J.—Newark will have another theatre on Market street, adjoining the State Bank Building. The plans have been submitted to Judge Krueger, who is back of the enterprise. The house will have a seating capacity of about 900. Ex-police Captain Charles Glori will manage it.

SISTERSVILLE, W. VA.—Mr. D. W. Daley, a prominent architect of Charleston, is in the city and has submitted plans to the F. & P. Bank for their new banking building, which will be erected in the spring.

NEW YORK CITY.—At the annual meeting of the American Society of Civil Engineers, at 23d street and Lexington avenue, it was announced that land had been purchased in West 57th street for a new society house, to cost $170,000. President, Thomas Curtis Clarke.

BUFFALO, N. Y.—The Buffalo Evening News will soon erect a six-story building, composed of marble and steel.

TOWANDA, PA.—Bradford County will have a new $150-000 court house.

BLACKSTONE, R. I.—The Secretary of State issued, January 1, a certificate of the organization of the Blackstone Electric Light Co. as a corporation with a capital of $10,000. The State Gas and Electric Light Commission will give a hearing January 25, at the Boston office, on issuance of stock of the company and determine the amount to be issued.

TORONTO, ONT.—The purchase of an electric light plant for the City Hall is strongly recommended.

ATHENS, ONT., is the home of an electric light agitation. If the agitation is big enough the Athenians will get the light.

SAVE YOUR POWDER FOR PRIVATE GAME.

The following communication explains itself:

LINWOOD, O., January 13.

Publishers ELECTRICAL AGE:

Since January 1 the village of Linwood has become a part of Cincinnati, through annexation, consequently her electric plant is now Cincinnati's property and is being run by Cincinnati officials. I say this so you may in some manner announce it in your paper, that your advertisers may not expend time and money further in sending the Linwood Water-works and Electric Light plant the multitudinous lot of circulars, quotations, letters, testimonials, samples, etc., etc., we have been receiving since 1893.

Yours, H. E. BYRON,
Ex-Secretary.

A HANDSOME CALENDAR.

The Cleverly Electrical Works, 1018 Chestnut Street, Philadelphia, is distinguished this year in other things besides its excellent electrical supplies and specialties. It has issued a calendar that stands superior to anything we have yet seen in this line in the way of art and size. Friend Cleverly has an eye for the beautiful as well as one for business.

A. O. Schoonmaker, 158 William street, New York, is now prepared to furnish mica disks, washers of all sizes stamped out of India or amber mica. If you want anything in mica write to him for information.

Trade Notes.

The Standard Boiler Co., of Chicago, report a good business during the past year. They have moved into their new offices, 1120 and 1121 Marquette Building. The Standard boilers are built by the well known firm, the Link-Belt Machine Co., of Chicago, who have put in new and improved machinery for their manufacture, reducing the first cost as well as making the various parts interchangeable. During the past year a number of fine plants have been installed; amongst others being, 4,000 H. P. for the North Chicago Street R. R Co., at their new power station at Hawthorn avenue; 500 H. P. for the Cincinnati Edison Co., at Cincinnati, O.; 600 H. P. for the Western Electric Co., at their factory in Chicago, and various others. The Company reports prospects good for the coming year.

ELECTRICAL and STREET RAILWAY PATENTS

Issued January 24, 1896.

552,890. Manufacture of Carbide of Calcium. William C. Clarke, New York, N. Y. Filed Aug. 24, 1895.

552,897. Messenger-Call System for Buildings. Henry Denver, Springfield, Mass., assignor to the Universal Electric Messenger-Call Company, Portland, Me. Filed June 24, 1893.

552,924. Electric Releasing Device. Stewart H. Reynolds, San Jose, Cal. Filed Mar. 13, 1895.

552,927. Car-Fender. James T. Rodgers and William L. Crowson, Memphis, Tenn., assignors of one-half to E. W. Smith and Kirk Allen, same place. Filed Apr. 2, 1895.

552,933. Electric Bell. Charles B. Sterling, New York, N. Y., assignor to the Dewey Electric Signal Company, same place. Filed Sept. 3, 1895.

552,954. Automatic Electric Releasing Device. John W. Chute, San Jose, Cal., assignor of one-half to James White, same place. Filed Apr. 16, 1895.

552,961. Electric Motor. Dugald C. Jackson and Conrad M. Conradson, Madison, Wis. Filed July 26, 1895.

552,967. Electric-Arc Lamp. Lars G. Nilson, Sioux City, Iowa. Filed July 25, 1893.

552,972. Telephonic Apparatus. Carl J. Schwarze, Adrian, Mich. Filed Apr. 22, 1895.

552,982. Electric-Arc Lamp. Frederick J. Borland, Leeds, England. Filed Aug. 17, 1894. Patented in England, June 27, 1893, No. 18,115.

553,014. Electric-Circuit Connector. Thomas F. Nevins, Brooklyn, N. Y. Filed May 16, 1895.

553,020. Car-Fender. Serenus H. Rodick, Bar Harbor, Me. Filed Jan. 9, 1895.

553,035. Driving Mechanism for Bicycle-Dynamos., George Mayr, Brooklyn, assignor of one-half to Elkin Farmer, New York, N. Y. Filed Jan. 5, 1895.

553,050. Car-Fender. William Burgey, Brooklyn, N. Y. Filed Oct. 4, 1895.

553,058. Street-Indicator. Charley Eby, Rocky River, Ohio. Filed Aug. 28, 1895.

553,061. Trolley Cut-Out. Theodore Fletcher, Idlewild, Tex. Filed Mar. 28, 1895.

553,079 Spark-Arrester. Edgar J. Solomon, Carlinville, Ill. Filed July 30, 1895.

553,099. Bonding Device for Electric Railways. Wilson Brown, Camden, N. J. Filed May 25, 1895.

553,106. Automatic-Closing Telegraphic Key. James A. Coleman, Perry Station, Canada. Filed Nov. 13, 1895.

553,155. Car-Fender. Steele Ellison, Philadelphia, Pa. Filed Oct. 28, 1895.

553,176. Electric Railway. Thomas F. O'Connor, New York, N. Y. Filed Apr. 2, 1894.

553,179 Telephone Circuit. Edward Slade, Newton, and John S. Stone, Boston, assignors to the American Bell Telephone Company, Boston, Mass. Filed July 12, 1895.

553,181. Sparker for Gas and Gasoline Engines. Frank M. Underwood, Upper Sandusky, Ohio. Filed Mar. 14, 1895.

553,186. Car-Fender. Charles A. L. du Quesnay, New Orleans, La. Filed Aug. 2, 1895.

553,194. Clip for Supporting Electric Cables. Russell H. Lewis, Providence, R. I., assignor of one-half to Oscar Noble Bender, same place. Filed Oct. 30, 1895.

553,198. Automatic Lighting or Extinguishing Apparatus. Samuel C. Stickle, New York, N. Y., assignor of two-fifths to Sproull, Harmer & Sproull, same place. Filed May 10, 1895.

553,208. Car-Fender. William S. Clement, Westmont, N. J., and Charles F. S. Mann, Philadelphia, Pa.; said Mann assignor to said Clement. Filed May 2, 1895.

533,220. Electric-Lamp Support. James Buckner, Boston, assignor, by mesne assignments, of one-half to Charles F. Fellows, Chelmsford, Mass. Filed June 10, 1895.

ELECTRICAL AGE

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THE ELECTRICAL AGE PUBLISHING COMPANY,

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NEW YORK.

NEW YORK, FEBRUARY 1, 1896.

CONTENTS.

AN ELECTRICAL CRUISER.

We wonder how Senator Hill felt and what he thought when he introduced in the United States Senate, last week, a bill authorizing the construction of an "electrical cruiser," to be equipped with "a system of electric motors and propellers" invented by one Richard B. Painton. The inventor claims that a speed of 35 knots an hour can be maintained by cruisers thus equipped. The Senator certainly knows that such radical developments in any science never take place in one jump. Mr. Painton's aim is high, but he should be patriotic enough to save the people's money and not encourage its expenditure on something that promises so little.

WHAT IS "UNDUE HEATING?"

We call the attention of our readers to the views of several eminent electrical authorities on the subject of "undue heating" in electrical conductors, as expressed in communications printed on another page. These expressions were elicited in an endeavor to answer an apparently simple question propounded by a subscriber who is seeking after the truth, and while each one is important in itself, there is a lack of harmony when all are considered together. The safe carrying capacity and "undue heating" of wires are matters of great importance, and yet authorities differ as to what one of the terms really means. There is an opportunity here to give the term "undue heating" a more definite meaning than it now has, and some of the electrical organizations should take the matter up.

THE ELECTRICAL EXPOSITION.

Judging from reports there is every reason to believe that the great electrical exposition which will be held in New York next June will be a great success. The promoters are all well known in the electrical trades and profession, and with their experience they certainly ought to make a success of the undertaking Dog shows, horse shows, poultry shows, cycle shows, etc., take well in New York, and an electrical show should prove a big card. The New York people like to see new things, and they will appreciate a sight of the wonderful things that electricity can accomplish. The time of this exposition is happily selected. New York appears at its best in June, and there is lots of life in the people.

PLUS AND MINUS.

The Philadelphia and Reading Railroad Company during the past year received a practical lesson in the effect of competition by electric suburban railroads. The annual report of the receivers of that company shows that the earnings from passenger traffic decreased $178,887 during the year 1895. This is a plain admission of the popularity of electric railroads, and the effect of their operations in many sections of the country is plainly felt in the treasury of some of the large steam lines.

TO INCORPORATE THE A. I. E. E.

A majority of the members of the Council of the American Institute of Electrical Engineers have issued a card to the members of that organization notifying them that a meeting of the association will be held on February 26, to act upon a proposition to incorporate the association, in pursuance of Section 5 of the Membership Corporations Law.

ACETYLENE GAS IS DANGEROUS.

A few days ago an explosion of acetylene gas occurred in New Haven, Conn., killing three men. This is a warning to those who are looking for a better illuminant than electricity. Electricity never asphyxiates nor explodes!

THE NATIONAL ELECTRICAL EXPOSITION.

On February 15 the National Electrical Exposition Company will close contracts for the entrance to the exposition next May, of steam-engines and boilers intended for exhibition. The time is short, and those who expect to have a display should give the matter of entrance their immediate attention. In an exposition of such magnitude everything must be planned and calculated beforehand, in order to avoid confusion at the last moment and consequent dissatisfaction. All friction of this nature can be avoided by attending to these matters at once.

Manufacturers of electrical goods of all kinds, who have not yet made arrangements for space, should do so at once if they do not want to be left in the race. Exhibits of novel, interesting and instructive nature have already been arranged for, and there is every promise that the vast undertaking will meet the most sanguine expectations of its projectors. It is stated that meetings of practical and professional electrical people will be held during the exposition, and this feature promises to be one of the most valuable and attractive.

NATIONAL ELECTRICAL EXPOSITION BUILDING.

The building in which the exhibition is to be held was erected for just such uses. There is not another structure in the city so large and well adapted for a large show. It is centrally located, being adjacent to the Grand Central station. The building is fire-proof throughout, and is modern in its entire equipment. There is ample room for a very large exhibition, but from the present outlook there will likely be none too much. Therefore, it behooves those who are delaying making arrangements to close matters as early as possible.

PRINCIPLES OF DYNAMO DESIGN.

Owing to some delay in preparing the drawings Mr. Harrison's contribution on dynamo design intended for this week's issue, has been omitted. It will appear in our next issue.

PRIMARY BATTERIES FOR DOMESTIC LIGHTING.

BY NEWTON HARRISON.

Of late many new forms of battery have appeared, the merits of which lead, individually, to their adoption either for continuous work or the running of electric bells, burglar-alarms, etc.

It may be believed by some that the primary battery has outlived its period of usefulness, and exists today simply as a defunct type of a once popular piece of apparatus.

This idea is wrong, because many more cells are sold today than ever before, and the rate of increase is very promising. To light a home by electricity would require the use of a reliable cell from which current could be obtained continuously, without great injury to its constituents or very heavy expense to the owner.

Let it be understood at the beginning that the present cost of zinc, acid and other accessories would entirely forbid the expectation of obtaining light as cheaply as if supplied from the electric light or gas company.

But in those cases in which a home is isolated from any source of supply of either gas or electricity, or if a water fall is in the vicinity, the use of the electric light in a small way would be very acceptable to the proprietor. Where available power is at hand it would, by the use of a dynamo, be not only a grateful light at all times of unsurpassed convenience, but it would be actually less expensive than gas.

There are no primary battery equipments, therefore, that can stand in open competition with the electric and gas companies of large cities.

Still, a small outfit will prove a source of interest to those possessing a desire to invest time and money in its construction.

A very popular form of cell is the carbon bichromate battery. A solution of bichromate of potash and water until the solution is nearly saturated will, with the addition of $\frac{1}{15}$ its volume of sulphuric acid carefully stirred in, prove an excellent liquid for the cell.

Never mix water with acid, but always the acid with the water. As a superior substitute for bichromate of potash use bichromate of soda, which is cheaper and in many respects better as a depolarizer.

It must be understood, in the selection of a useful type of primary battery, that the battery running longest with least renewals would be best if the expense is not too great.

The great and most desirable object in view in the improvement of primary batteries is a powerful depolarizer. A depolarizer being in such a case a chemical compound in fact a regenerator, with a strong tendency to combine with the hydrogen given off by the zinc. Should the hydrogen reach the conducting element it will prevent a further flow of current and render the cell, for the time at least, perfectly useless.

In the solution just mentioned zinc and carbon plates or rods dip, in order that the cell may be ready for action.

It is the usual practice to have a greater carbon surface than zinc, and to surround the zinc entirely by a cylinder of carbon or its equivalent in plates or rods.

A point of the utmost importance in such work, and which is usually neglected, is the treatment of the zincs.

The plate or rod of zinc must be thoroughly cleaned by dipping it into a solution of sulphuric acid and water of 15 to 1, as previously mentioned, and all foreign substances removed.

It is then thoroughly rubbed with mercury until every bit of it is glistening with mercury, which tightly adheres.

It may be tested by dipping it in the acid solution again to see if bubbles appear on its surface, due to any decomposition. If such is the case, it must be carefully rubbed with the mercury until it remains in the acidulated solution entirely unaffected.

Two carbon plates, six inches by five inches, and a zinc plate of equal size between, would give a steady current of considerable strength for 10 hours.

By this is meant that if the rate at which current is discharged be small the time will be long, while with the current very strong the time is correspondingly decreased.

Thus the capacity of the cell is limited and accommodates itself to the conditions.

From time to time the zinc must be examined, to see whether the amalgamation or mercury coating is intact.

By using a cone-shaped piece of zinc with a heavy copper wire connected, the mercury may be automatically supplied, if the zinc when placed in a porous cup and covered with diluted acid be dipping into a few ounces of mercury.

In the outer jar a bichromate solution can be used, with the carbons suspended in it.

The great secret of success with a primary battery outfit lies in the use of a special lamp. By buying a one or two-watt lamp the light obtained for little power is very great and the current more economically used.

A lamp of this kind, for instance, would be called according to its candle-power—a 4-candle-power, 2-watt lamp, or an 8-candle-power, 1-watt lamp, etc.

Quoting from a writer on the subject speaking of launches, the following is true: "An ordinary primary battery is not difficult to manage, and if a good form of solution is used, such as bichromate of potash, a long run, say of four or five consecutive hours, may be made by a light boat at a cost for motive power not exceeding 10 cents an hour, and even less."

From the test of a set of 60 cells, we have:

Size of cell,	$11 \times 12 \times 3$	inches
" porous cup,	$9 \times 11 \times 1$	"
" carbon plate,	$7 \times 11 \times \frac{1}{4}$	"
" zinc "	$7 \times 10 \times \frac{1}{4}$	"

Carbon suspended in the solution of porous cup, and two zincs in each outer jar.

In porous cup three pints of strong solution, and in the outer cell six pints of weak solution. The cost of solution is $1.60 for 60 cells. Output from one charge of solution, 180 ampere-hours. Each cell giving an E. M. F. of 1,875 volts. Waste of zinc, one pound per hour.

The enormous variety of types of batteries, the continued additions to the vast number already constructed and their secret solutions, would fill volumes were an attempt made to describe them. Yet the latest developments, the arduous labors of those seeking to solve a problem of recognized importance, have cleared the science of charlatans and speculators. To take a current from coal is the next problem to be solved. In the laboratories of Germany the work seems to be progressing. We await daily their results.

CABLES AND PIPES DAMAGED BY ELECTROLYSIS.

We are in receipt of advices from Pittsburgh to the effect that great damage is being done in Allegheny City and other suburban districts to underground electrical cables and underground pipes by electrolysis. Over $50,000 was recently expended in underground wires and these, the report indicates, have suffered very seriously. A big throttle valve is needed on the electric railway system in the Iron City.

MECHANICAL AND ELECTRICAL VIBRATIONS.

Editor Electrical Age:—The other evening as I was riding up town on the Elevated Railroad a leak or a break of some sort occurred in some of the steam apparatus under the car. The escaping steam produced a musical note, the vibrations being communicated to the body of the car. I noticed that the window-sash next to me was "rattling" very rapidly, which, of course, was due primarily to the vibrations produced by the escaping steam. I placed the tip of my right forefinger to the window-sash and I experinced a nervous sensation remarkably like that produced by an induction or medical coil.

It seems to me that this accidental experience goes far to prove that mechanical and electrical vibrations have precisely the same effects upon the nerves, providing, of course, that the mechanical vibrations are rapid enough. Having the same effect, is not the nature of the two phenomena the same, the apparent difference being only one of rapidity of vibrations? I am not a scientist, and as I had never seen any such experiences described in print before, I thought it might interest your readers to relate mine which, I think, involves many valuable facts.

Apologizing for encroaching on your space and time, etc.

A Constant Reader of the Electrical Age.

New York, January 25, 1896.

TELEPHONE OFFICE ON THE STRANDED STEAMER ST. PAUL.

A unique application of the telephone was made last week at Long Branch, N. J.

The grounding of the American Line steamer "St. Paul" off that place necessitated the use of some quick means of communication between the vessel and shore in order to direct the operations incident to hauling the ship off the sands. The problem was solved by the installation of a telephone on board, a line 1,200 feet long forming the connecting link between ship and shore. The line consisted of a twisted pair conductor composed of No. 16 hard-drawn copper wire of the Safety Insulated Wire and Cable Company's make. The conductor was run from the Long Branch Exchange to a 30-foot pole on a bulkhead, whence it was stretched to the "St. Paul," terminating in one of the staterooms which, for the time being, was transformed into a temporary long-distance telephone "pay station." The wire is kept busy, and the Long Distance Telephone Company keeps a man on duty all the time. President Griscom, of the International Navigation Co., Capt. Jamison and other officials made good use of the telephone in communicating with the company's headquarters in New York and Cramp's shipyard in Philadelphia, where the "St. Paul" was built.

There are about 700 feet of slack cable coiled on the steamer's deck to allow for the movement of the vessel as she is gradually hauled off. The cable is long enough to preserve the connection until the ship reaches deep water again, then the first marine telephone "pay station" will be closed.

We have received a copy of the first issue of *Home Study*, which is to be published monthly by the Colliery Engineering Co., Scranton, Pa. "Its province," according to the salutatory, "is to aid students of institutes, night schools, Y. M. C. A. classes and correspondence schools, and imperfectly educated readers of technical literature to acquire the knowledge of mathematics, physics and drawing, which they must have to obtain the best results in their efforts to improve themselves." The first (February) number is full of interesting matter of the character above referred to, which is written in very clear language and well illustrated. Every department of the paper bears evidence of the work of master hands. The first impression is sure to be a good one, and first impressions are lasting ones. *Home Study*, no doubt, will meet with much appreciation on the part of those whom it intends to benefit.

DEPARTMENT OF ELEMENTARY EDUCATION.

BY THE EDITOR.

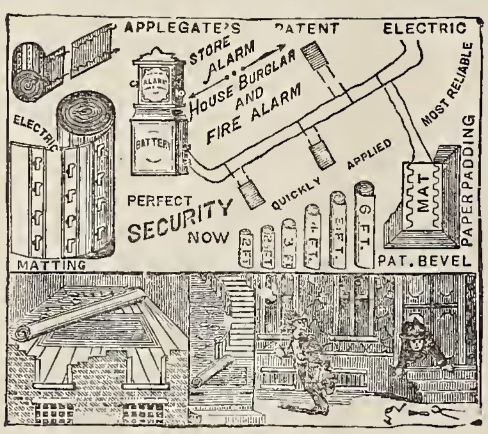
[*Note.—Any one is invited to ask questions on any point that is not made clear in these articles. Suitable explanations will be cheerfully given under the head of "Answers to Inquiries."*]

BURGLAR ALARMS.

(*Continued from Page* 43.)

A valuable adjunct to a burglar alarm equipment is electric matting. This is placed under the carpet at the doors so that in stepping on the matting the electric circuit is closed and the annunciator indicates whence the intrusion. The matting can be placed in front of doors, under windows, on stairways and in any other place where a burglar would likely go if he succeeded in getting inside of the house.

The idea has been carried out further by connecting to the burglar alarm circuit automatic electric gas burners, so



ELECTRICAL MATTING.

that when the intruder attempts to gain an entrance into the house the gas burners are automatically lighted and at the same time the burglar alarm sounds. If the burglar persists in going ahead in his plans in the face of such odds he must be a very reckless sort of an individual.

One of the essentials of a burglar alarm is the annunciator. An annunciator is an instrument which automatically indicates whence an alarm comes. It tells the exact place where the burglar is trying to get in—a window or a door.

A diagram of a simple burglar alarm, the annunciator having two indicators, is shown in Fig. 13. One window and one door are provided with a push or circuit-closer, each push having its own indicator on the annunciator. In opening the window, for instance, the indicator card will drop and show the word "window" or whatever other

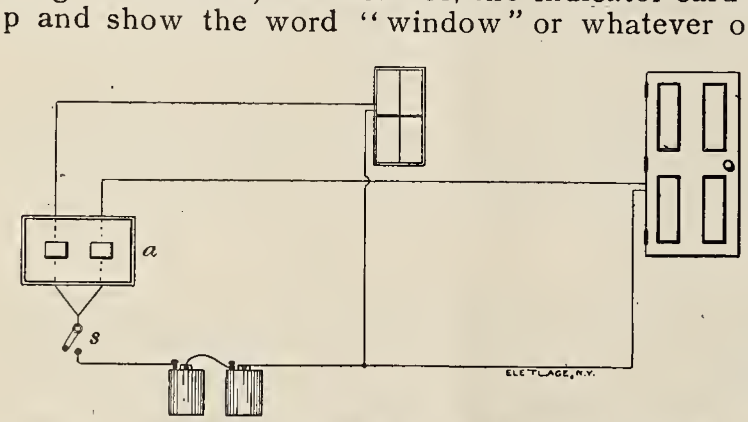


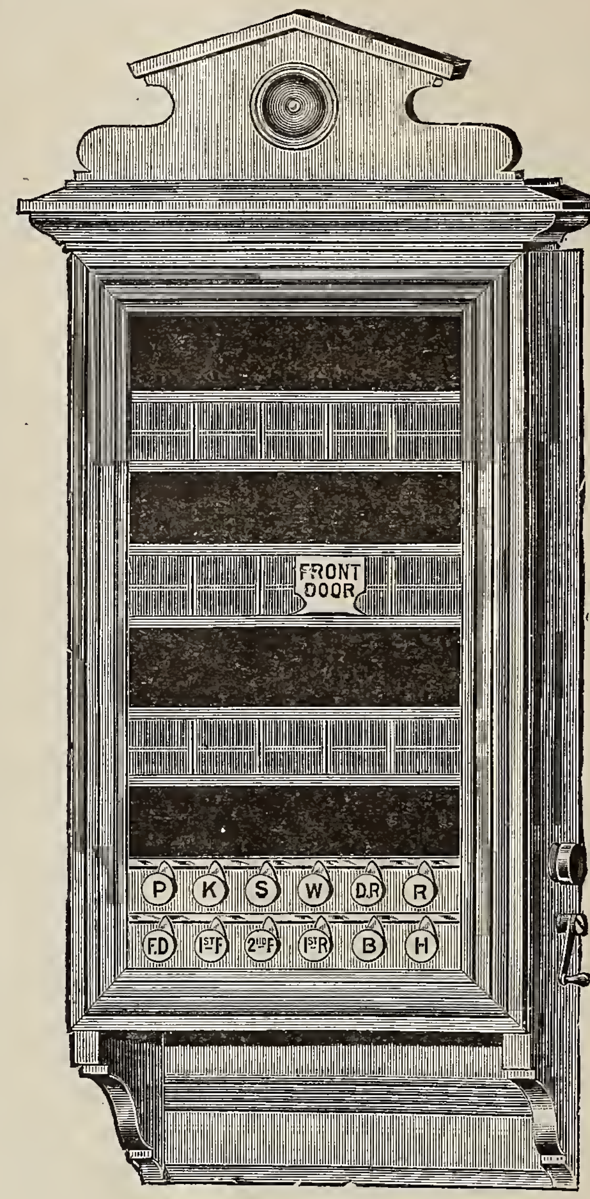
FIG. 13.—BURGLAR ALARM WITH TWO CONNECTIONS.

designation we may give the particular push. The same applies to the door. If six windows are provided with circuit-closers we must have six drops for them or the annunciator; in short, we must provide an annunciator with as many drops as there are window and door connections.

Each door or window circuit-closer acts precisely like the push-button in ordinary electric-bell circuits. It does more than ring the alarm, however; it operates the indicator drop, which in turn shows the location of the circuit-closer that rang the alarm.

S in Fig. 13 represents the switch, which is turned in the manner shown during the daytime. *A* is the annunciator with two drops.

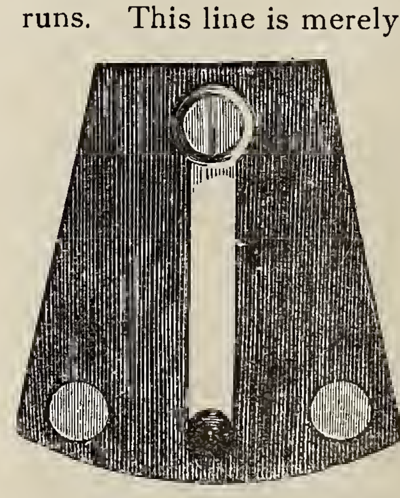
Fig. 14 shows a burglar alarm circuit with five connections. There are six indicators on the annunciator, but only five of them are used. This illustration shows in a clear manner how the connections are made and carried out. It will be noticed that every window and the door is connected with the annunciator by one direct wire; all can



ANNUNCIATOR.

use the same return wire, however, as shown. When the circuit is set all the door and window connections are open, of course.

From the annunciator A to the battery B a dotted line runs. This line is merely to indicate the connection with



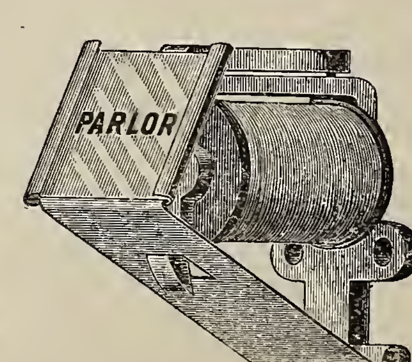
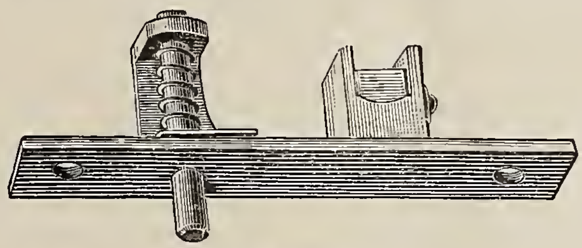


FIG. 12.—SWITCH. MECHANISM OF ANNUNCIATOR DROP.

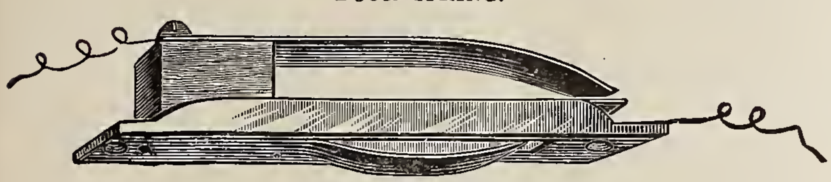
a continuous-ringing attachment, with which every burglar alarm should be provided.

In case two or more windows and doors of the same room are equipped with circuit-closers, they can all be connected with one annunciator drop, the circuit-closers being connected to the main circuit in multiple, as explained in the second paragraph under the head of this department on page 30 (January 18th issue). Of course, in such an arrangement as this, the indicator drop refers to the *room* itself and not to any particular window or door. In the daytime, when it is necessary to open doors and windows, provision must be made to permit of this without ringing the alarm each time. This object is accomplished by turning the switch (Fig. 12), which prevents the current from flowing out of the battery. In some annunciators each circuit is provided with a similar switch, so that any one or more connections may be maintained and others opened, according to circumstances.

Fig. 15 shows one form of window-push, or circuit-closer, Fig. 16 a form used for doors. The operation of each is so obvious that no explanation need be given here.



DOOR SPRING.



WINDOW SPRING.

There is a window-spring which permits of the ventilation of a room without interfering with the alarm. It is known in the trade as the ventilating window-spring. The window can be set at any desired height, and so arranged that to raise it a little higher than the fixed position the alarm goes off. Thus, if the window is set to a space not quite large enough for a man to crawl through, and a thief should attempt to gain an entrance by the partly-open window, he would start the alarm by raising the sash a very little.

For a simple and cheap burglar alarm an ordinary electric bell will answer, instead of a regular annunciator. Of course, with a bell there will be no visible indication as to what point the alarm is rung. But for many places the audible alarm is sufficient. Such an alarm is very easy to install, and the work is practically the same as that in electric-bell circuits.

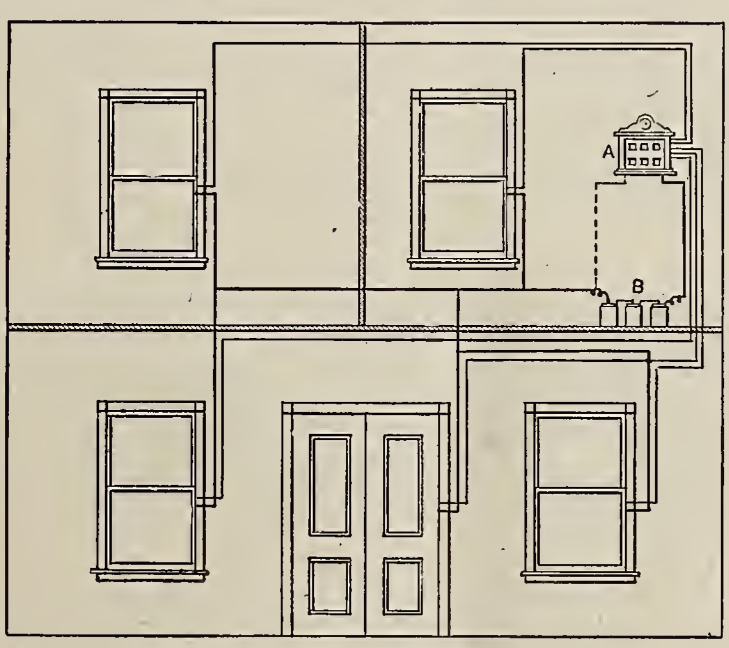


FIG. 14.—BURGLAR ALARM WITH FIVE CONNECTIONS.

A system that is indispensable in some places is the combination annunciator and automatic clock-work cut-out. This instrument provides means for opening doors and windows by the servants on rising, without disturbing anyone where the annunciator is located. The clock-work automatically cuts out any desired sections of the system at the hour set.

The foregoing gives a general idea of burglar alarms for windows and doors. There is, however, another very important application of the same principle which should be referred to, and that is to desks and safes. The closed circuit system is used for this special purpose to insure greater protection.

In the closed circuit system the current is flowing continually while the alarm is not ringing, but should the desk or safe-door be opened the circuit would be broken and the alarm would ring. This system is always used for the protection of safes, principally because the alarm works instantly should a burglar discover the wires and cut them or otherwise tamper with them.

In this system an ordinary electric bell is used, there being two batteries—one for the open circuit and the other for the closed circuit, both classes of circuits really being required for the "closed-circuit" connections. The open-circuit battery is connected with the bell in the same manner as in an electric door-bell, except that the circuit is continuous without a break. The closed-circuit battery is connected with the alarm connections and the bell magnets, and when in position for work is also a continuous circuit without a break. This circuit is connected only to the magnets, the current flowing through the magnets continuously. This current holds the armature close up to the magnets, thereby keeping open the open-circuit battery by holding the armature away from the contact screw. The moment any connections are tampered with or wires are cut, and the closed circuit is thus opened, the armature flies back from the magnets, closes the open circuit at the contact points and causes the alarm to ring until the proper attention is given to it. The excellence of the closed-circuit system for such uses lies chiefly in the fact that the alarm always rings when anything gets out of order.

ANSWERS TO INQUIRIES.

[*Note.—This column is open to any of our readers who desire special information on any subject. In case we cannot give the desired information ourselves the inquiry will be published, in order to elicit a reply from some one of our readers. These answers will be published in due course.*

The full names of our correspondents will not be published, but for the purpose of identification their initials or other mark of identity will be substituted therefor.

Each question will be numbered for the purpose of ready reference.

All are invited to make free and liberal use of this column.]

21.—What is the meaning of "unduly heated" in the definition of safe carrying capacity of a conductor—which definition is, according to Houston, "the maximum electric current the conductor will carry without becoming unduly heated." H. J S., Montreal.

A.—We started in to answer this question thinking it was an easy one, but the more we investigated the more we became convinced that the term "unduly heated" was a very elastic one and represented a very unstable quantity. We therefore appealed to several gentlemen high in authority in such matters and they have very courteously given their views on the subject. We append their replies:

School of Mines, Columbia College,
New York, Jan. 7, 1896.

Editor The Electrical Age:—In answer to your inquiry of 3d inst. I would say that "unduly heated" depends much upon circumstances. In general it means that the temperature shall not be sufficient to injure insulation or cause other injury. Of course, any heat which is bearable to the hand is perfectly harmless; hence this test is a rough but very safe one.

In dynamos or motors the allowable rise in temperature for coils or other parts is 40° or 45° Cent., as measured by a thermometer placed against the surface and covered over with cloth.

In wiring the most usual standard of safe current capacity is that number of amperes which, if doubled, will not raise the temperature above 150° F.

You will find safe carrying capacity quite fully discussed in Abbott's recent book on Electric Transmission.

Very truly yours,
F. B. Crocker.

From the Laboratory of Thomas A. Edison,
Orange, N. J., Jan. 9, 1896.

Editor Electrical Age : I have your letter of the 6th, and in reply would say that my opinion is that the meaning of "unduly heated" as expressed in your letter would mean that the conductor should not heat more than 212° Fahrenheit, or the heat of boiling water.

Yours very truly,
Thomas A. Edison.

Schenectady Technical Association,
Schenectady, N. Y., Jan 7, 1896.

Editor Electrical Age :—Replying to your favor of the 4th inst., would say that the term "unduly heated" has, directly, less to do with the point at which the insulation is destroyed, or at which the wire becomes too hot to touch, than with the point at which the ratio of the *energy spent in the wire* to the *total energy transmitted* becomes excessive for the particular purpose. Since the limit of this ratio, $\frac{C^2R}{C \times E}$, greatly varies for different purposes (line wiring, armature-winding, magnet-winding, etc.) the "undue heating" also ranges between very wide limits. For indirectly, of course, the energy absorbed by the wire, together with its radiating surface and with the condition of the surrounding, determine the temperature of the wire. Figuring the temperature-increase for the "safe carrying capacity table" given by the National Electric Light Association and the Fire Underwriters, by means of the formula

$$t = .00045 \times \frac{C^2}{d^3} \left(\begin{matrix} C = \text{current in amperes.} \\ d = \text{diam. of wire in ins.} \end{matrix} \right)$$

which has been found to meet the practical truth for the case of bare copper wire, the limit of the temperature-rise is obtained as $t = 40°$ C. or 72° Fahr., and the final temperature $T = 60°$ C. or 140° Fahr.

Hoping the above is satisfactory, I remain

Yours very truly,
Alfred E. Wiener.

Bound Brook, Jan 7, 1896.

Editor Electrical Age :—Your inquiry of the 6th received. I would say a conductor carrying a current was "unduly heated" when the temperature was sufficiently high to impair the insulation with which it was surrounded. This is my idea of the matter, but others might define it at the point at which it would burn the building down.

In this connection it strikes me that some insulations are more easily damaged by heat than others, and taken together with the variable surrounding conditions would seem to me to be a hard problem to draw a fine line just where the "safe carrying capacity" ends. Still there are tables which come near enough for practical work, although I have no doubt they may be improved upon.

Yours truly,
Osborn P. Loomis.

Works, Crocker-Wheeler Electric Company,
Ampere, N. J., Jan. 4, 1896.

Editor Electrical Age :—In reply to yours of the 3d inst. would say that "unduly heated" does not mean a rise of temperature to the point of the destruction of insulation, but a rise to a point which has been fixed by experience as that which not only is safe in itself but allows that factor of safety to cover unforeseen conditions, which is absolutely essential to all engineering.

For wires inclosed in moulding, unduly heated would mean if we adopt the Edison regulations as modeled after the researches of Mr. Kennelly, a rise of temperature of more than 18° Fahr.

In the case of dynamo windings, unduly heated would mean a rise of temperature greater than 81° Fahr., the figure usually specified by engineers and builders.

Yours very truly,
Gano S. Dunn.

General Electric Company,
Lynn, Mass , January 23, 1896.

T. R. Taltavall, Editor, Electrical Age.

Dear Sir:—Owing to press of work and correspondence it is difficult to keep up with, I find that your letter of January 6 has remained unanswered until now. It may be too late to make any reply to the query which you send, namely, as to the meaning of "unduly heated" in the definition of the safe carrying capacity of a conductor.

I should say that, so far as I know, there is no definition of the term which could be translated into so many degrees Fahrenheit or Centigrade, and my own understanding of it is that the heat must not increase to a point to endanger or injure the quality or the nature of the insulating material, or to char or begin to char or decidedly soften the enclosing or surrounding insulation. It is safe to say that when a wire is so heated as to be noticeably hot,—quite hot to the hand, the ordinary insulating materials are on the point of injury.

In the construction of dynamos and motors it is now customary to set a limit to the heating in making contracts or specifications, the usual statement being that a certain number of degrees Centigrade above the temperature of the surrounding air is to be taken as the limit of temperature under full load. This practice is, of course, far more definite than the mere statement "undue heating." As it is, however, quite a difficult matter to measure the temperature of wires, especially small wires carrying current, it would be, of course, proportionately more difficult to set certain definite limits to the heating of wires than in the case of large structures like dynamos.

It only remains to remark in this connection that the temperature which a wire may attain while carrying current would largely depend upon its location. In one location it might become unduly heated, while in another location it might remain quite cool, relatively. Thus, if a wire were run near a steam-pipe, its original temperature plus the temperature due to the passage of current might carry it beyond safe limits, or if the same wire were enclosed in a heat non-conductor, such as soft wood moulding, or the like; its temperature might rise far beyond the point which would be reached if the same wire were fully exposed to the air. The circumstances vary so greatly that the only safe rule is to use such a wire as will, under a great variety of circumstances, still remain within safe bounds as to temperature. Fortunately the use of such a size of wires as will carry a current without producing any considerable increase of temperature is conducive to the best economy in the saving of energy and saving the drop on lines which, of course, has a detrimental effect on the regulation of potential of current supply.

Yours truly,
Elihu Thomson.

22.—Having an ammeter and a known resistance, how can the resistance and the E. M. F. of a circuit be found without any other instruments? C. P. L., Monmouth, Ill.

A.—Three factors enter into the calculations of electric currents, viz: electromotive force, resistance and current. When any two of them are known the third one can be found by division or multiplication, according to Ohm's Law, as follows :

$$C = \frac{E}{R} \; ; \; R = \frac{E}{C} \; ; \; E = C \times R.$$

(In these formulas, C denotes current ; E, electromotive force, and R resistance.) Our correspondent wishes to find the value of two of the factors—namely, the resistance and electromotive force—which cannot be done. It is practically the same as trying to find out from the amount of water ejected by a water faucet how far away the source of water is and what head it has. The ammeter will show in amperes the amount of current flowing in the circuit, but there is no way of ascertaining from the current alone the value of the electromotive force which produces it and the resistance which limits it in quantity.

ELECTRICITY AT THE CYCLE SHOW.

There was considerable artistic talent and ingenuity displayed in the design of the various electrical signs at the Cycle Show in Madison Square Garden, last week.

The Pope Manufacturing Co., of Hartford, Conn., had a large space, down the centre of which, and overhead, was an artistic box sign with the words "Columbia Bicycles, Standard of the World," in electric lights on both sides. At each end of the box was the company's well-known trade-mark, executed in an effective manner.

The word "Sterling," referring to the wheel of that name, was artistically wrought in stained glass, and illuminated by electricity.

The "Liberty" sign attracted much attention. Each letter was illuminated, one after the other; in this way the word "Liberty" was spelled out in flaming characters.

One of the handsomest and artistic designs was the "Stearns" sign. The word "Stearns" was executed in script letters, and at each end was a handsome pendant basket lamp, hanging from antique iron brackets. At each end of the sign was a beautiful opalescent globe set on the surface, the whole giving a beautiful effect.

The Buffalo Cycle Co. had a novelty in the shape of a wheel with electric lamps arranged radially around the rim and a Buffalo head in the centre.

Other wheels with attractive electric signs were the "Spalding," "Crescent," "Waverley," "Cleveland," "Sterling," "Remington." "Warwick," "Outing Bicycle," "Fowler," etc.

On entering the vast building the first thing to attract the attention was the immense wheel at the further end of the auditorium, outlined with electric lights, and both wheels revolving. The words "1896 Show National Board of Trade" were displayed around the big wheel.

At the Madison Avenue end of the Garden was an electric American flag, the lights of which were extinguished and lighted in such a manner as to give the effect of waving in the breeze. Below the flag was the L. A. W. emblem, wrought in small electric white and red lamps.

The Columbia Hard Rubber Co., of this city, had an exhibit of its celebrated pneumatic tires and repair outfits. This company's stall always attracts a crowd. The repairing is so easily and effectively done that wheelmen at once become interested in the manner of doing it.

The show was the most successful ever held by the National Board of Trade, over 100,000 persons visiting the vast building during the week.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The 102d meeting of the Institute was held at 12 West 31st street, Wednesday evening, January 22, at which a paper was read by Mr. F. J. Sprague on "Electric Elevavors, with Description of Special Types." The paper was fully illustrated by lantern slides, and the practical operation of the electrical controlling apparatus was shown by a working exhibit of the essential parts on the platform. The paper was discussed by Messrs. Steinmetz, Hill and Leonard, but owing to the lateness of the hour further remarks were postponed until the next meeting.

At the meeting of Council in the afternoon the following Associate Members were elected:

Cunningham, E. B., superintendent Fort Dodge Light and Power Co., Fort Dodge, Iowa.

Edgar, C. L., general manager and chief engineer, Edison Electric Illuminating Co., Boston, Mass.

Evans, Edward A., acting-chief engineer, The Quebec, Montmorency and Charlevoix Railway, Quebec, Canada.

Franklin, W. S., professor of physics, Iowa State College, Ames, Iowa.

Githens, Walter L., manager, H. P. Electric Light and Power Co., 7284 S. Chicago avenue, Chicago, Ill.

Jijima Zentaro, Wagner Electrical Manufacturing Co., 2017 Lucas place, St. Louis, Mo.

Lemon, Charles, Hon. Secretary for New Zealand for the Institution of Electrical Engineers, Palmerston, North New Zealand.

Lloyd, John E., assistant-chief engineer, Philadelphia Traction Co., Philadelphia, Pa.

Moore, Wm. E, electrician and superintendent, The Augusta Railway Co., Augusta, Ga.

Nichols, Geo. P., Geo. P. Nichols & Bro., electrical engineers and contractors, 1036 Monadnock Building, Chicago, Ill.

Potter, Wm. Bancroft, engineer railway department, General Electric Co., Schenectady, N. Y.

Wagner, Edward Andrews, electrician, The Mexican International R. R. Co., Eagle Pass, Texas.

CLEVELAND & TAYLOR.

Cleveland & Taylor, the well-known firm of electrical contractors, 5 and 7 Dey street, New York city, recently installed a noteworthy electric light plant. This installation was in the U. S. Sub-Treasury, on Wall street, and the work was one of great difficulty, requiring the exercise of much ingenuity. The walls of the building are four feet thick, of solid granite and masonry, and the wires had to be carried through these walls.

The building is divided into four sections for lighting purposes, each section being wired with separate mains, the mains in turn being connected to the switchboard. There are 450 16-c. p. lamps in all. The gold and other storage vaults were wired and installed with lamps, and the whole work was done under the constant surveillance of Uncle Sam's officers.

The switchboard is of the Electric Engineering and Sup ply Company's make, and was contracted for by F. W. Hawkins, the company's New York agent. It is made of marbleized slate, with angle-iron frame, inclosed in fine cabinet work.

There are four main-line switches, and the current is taken from the subway of the United States Light and Power Company's system.

Bishop White Core insulated wires and cables are used throughout the installation. The fixtures include Edison cut-outs, E. E. & S. Co. rosettes, N. E. switches and Circular Loom conduits.

The installation is complete in every respect and can be connected at anytime to an isolated steam plant without material change.

Messrs. Cleveland & Taylor are young men and experienced in the electrical business. They have the facilities to insure the best work, whatever may be the magnitude of the contract.

Among the contracts they now have in hand are the wiring of the residence of Mr. Busby, for 150 lights; residence of J. L. Lawrence at Cedarhurst, L. I, for electric light, burglar alarm and bells; new restaurant of S S. Childs, 221 Sixth avenue, New York, 5 H.-P. Lundell motor, 10 Diehl & Co.'s arc lamps and 50 16-c. p. incandescents.

They are also selling and installing the telephones of the American Electric Telephone Co., and have recently installed 16 sets in Dunlap's hat factory in Brooklyn, where the instruments are giving excellent satisfaction.

FIRE AT THE GARVIN MACHINE WORKS.

The works of the Garvin Machine Co., at the corner of Canal and Laight streets, New York, were damaged by fire one day last week. The fire loss was small, the principal damage being done by water. Business, however, was not interrupted by the visitation. The company continues to promptly fill all orders.

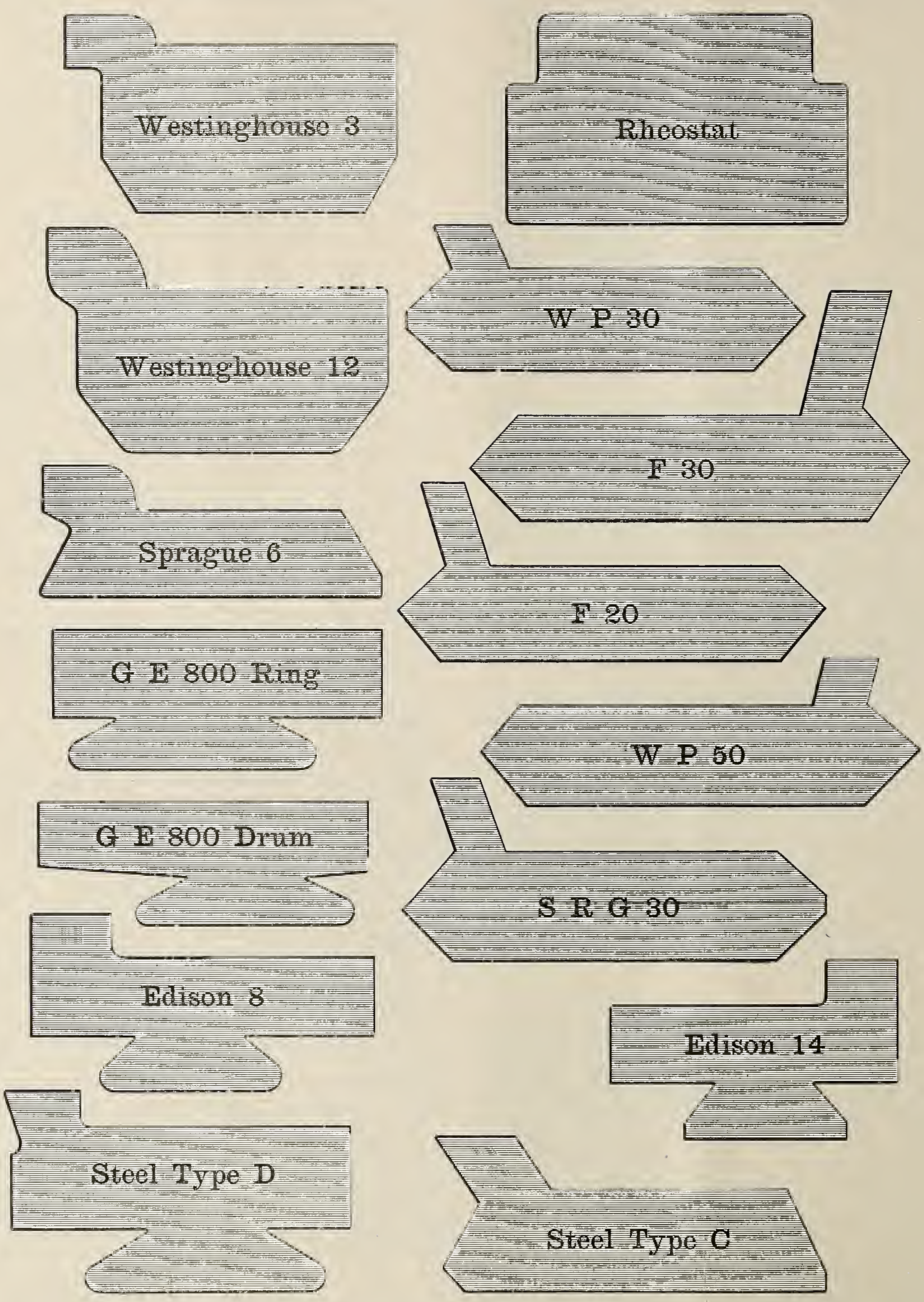
MICA FOR ELECTRICAL USES.

One of the most valuable electrical insulating substances known is mica.

Mica is a mineral, and is either colorless or presents some shade of light brown, gray, smoky brown, black and occasionally green or violet. It is, however, generally more or less transparent. It is capable of being cleaved into plates or sheets of extreme thinness. It is a dielectric as well as an insulator, and as an insulator its resistance per cubic centimeter, after several minutes' electrification at 20° C. (68° F.) is 84×10^{12} ohms. Its specific inductive capacity is 5, air being taken at 1.

Mica is very extensively used in insulating commutator segments and armature cores, and nothing has been found to equal it for this purpose. It is very easily shaped and is practically indestructible by heat.

Mr. A. O. Schoonmaker, 158 William street, New York, is one of the largest dealers in mica for electrical purposes in this country, and the accompanying illustration shows some of the forms of solid sheet mica commutator segments for railway motors kept in stock by him.



Mr. Schoonmaker handles only the best India and amber mica in the rough and cut to any size. The segments are stamped out of solid sheets.

Our second illustration shows a series of amber mica washers and rings of different diameters for dynamos, motors, etc. This amber mica is the best quality obtainable and is a product of Canada. It is carefully selected, especially for electrical uses.

The India mica is especially imported from the native mines by Mr. Schoonmaker. It is selected stock of guaranteed purity, and no region in the world produces a better article for insulating purposes.

It is perfectly free from iron, thus rendering its non-conducting properties of the very highest order. It splits evenly, and has a uniform, smooth cleavage.

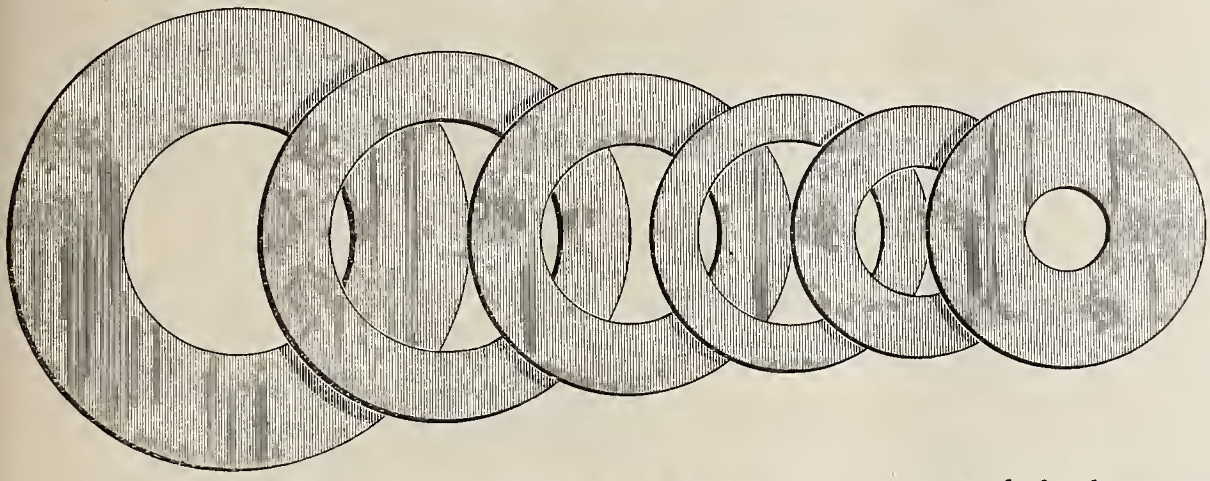


FIG. 2—MICA WASHERS.

This mica has been used constantly by many of the largest and most prominent electrical companies in the country, and has given perfect satisfaction.

PERSONAL.—The Perkins Electric Switch Mfg. Co., of Hartford, Conn., have appointed Mr. C. I. Hills manager of their sales department, with headquarters in New York, at Room 219, Havemeyer Building.

PRACTICAL EXPERIENCE WITH STORAGE BATTERIES IN CENTRAL STATIONS.*

BY C. L EDGAR.

(*Concluded from page* 18.)

Our generating department has gone through some exhaustive experiments, running first the engines for 24 hours a day, charging the battery at minimum load, and then turning around the next week and shutting down the steam plant for the six hours from midnight until six o'clock in the morning, and depending entirely upon the battery. The general conclusion seems to have been arrived at that the former is the cheaper method Admitting this, the indirect advantages of the former, by which the battery is charged during the night and can be used during the following day, are very much greater than if the battery were discharged during the night, as it could not be completely charged again until the middle of the afternoon of the following day.

I do not consider our conclusions final, as the local conditions might materially change the result. In our case it happens that the output at night plus the charging current of the battery, is just equivalent to one of our standard units. If it were necessary to run two units to do this work, our conclusions might have been different, so that I think this is a case which has to be decided in each place on its own merits.

Third, to act as an equalizer or a reservoir.—It is this use of the battery with which we have been particularly pleased, and in order to understand, it is perhaps desirable to explain the needs which a modern station has for apparatus of this kind. Years ago a distribution company was equipped with one station, furnishing electricity through a system of feeders, supplied from one 'bus bar. All this is changed. Today the modern station manufactures electricity in various places, transfers it from one station to the other at will, sends it out through a system of distribution at three or four pressures supplied from 'bus bars of varying potential. At the minimum hours of the day the electricity is manufactured by one set of dynamos, part of it being delivered to the 'bus bar in the station in which the dynamos are located, the remainder being sent out over tie lines to various annex stations and delivered there to the local 'bus bar. The amount of current is so smal compared with the capacity of the various circuits that, practically, the pressure delivered at the lamps is constant, notwithstanding the various roundabout ways in which it reaches them.

As the load begins to increase, the drop over the tie lines becomes noticeable, and it is necessary, by means of auxiliary dynamos known as boosters, to raise the potential of that part of the output which is delivered to the tie lines.

The load still increasing, it is necessary to start additional dynamos. These may be thrown in multiple directly with the original pair and deliver the same potential as the others, or, if the condition of the load warrants it, they may be thrown in multiple with the original dynamos and the booster in series and deliver the potential needed by the tie line. In this case the booster might be taken out of circuit.

The load on the tie line again increasing, the booster would be again put in use and we would thus have the condition of a tie line supplied partly by a dynamo of the proper potential, and partly by additional current furnished by a booster, raising the potential from another 'bus bar supplying current locally.

This goes on until nearly the maximum load is reached. It then may be found, as it is sometimes in our case, that the original or main station is not equipped with sufficient dynamos to supply the local distribution. In this case the current over the tie line is reversed, and the annex station sends current to the original station, which arrives there at somewnat lower potential than is needed, and is there raised by means of a booster to the 'bus bar of that station. It is necessary to understand that these are every-day occurrences, and if we were not equipped with a battery it would be almost an hourly question as to what it was necessary to do next, whether to start dynamos, stop them, change boosters or any other of the innumerable combinations which might be made. This trouble is intensified by the uncertainty as to what changes are going to take place in the output, and what the load is going to be at any given time. In a very large degree the battery answers all these questions, or at least makes them unimportant. It makes it possible to determine beforehand what the regular day's work of the steam plant is to be, to decide how many and at what time boilers are to be put in service, when engines are to be started or stopped, and in general to operate the plant to its best economy, knowing that daily or hourly inequalities in the load, or uncertainties caused by the weather, will be taken care of by the battery.

It is kept in multiple with one or the other or all 'buses at all times. It is supposed, for many hours of the day, to be standing idle with the ampere meter at zero, but it may, without a moment's warning, be called upon to either give or take anywhere from one to 3,000 amperes on a side. It is possible in this way theoretically to keep every engine which is running loaded up to its maximum economy at all times. Practically we have found it possible to never operate an engine with less than three-quarters load. The economy of the steam plant then more nearly approximates what is known as mill practice, which is the goal toward which we are all striving.

Having satisfied ourselves in the beginning that with a given amount of capital we could do more work with the battery than without it, we by actual practice came to the conclusion that we could by the same means do this same amount of work more cheaply. When we remember that we installed the battery for the express purpose of taking care of the maximum load, we are, of course, particularly pleased at the very great use we can make of it for this purpose of equalization, and yet, in addition to this, we have made enough tests to prove to our own satisfaction that we do not lose anything in fuel economy by this particular use of the battery. The watts lost by the inefficiency of the battery are made up more than fourfold by the better economy of the steam plant. We have taken typical winter days and figured out exactly the cost of running our system with the battery and without, and have proved that the actual coal consumed with the battery is a material amount less than without it. If, in addition to the fuel, we take into account the very great saving in the labor, the added reliability and the better service given, we will see that these uses of the battery are even greater than those for which it was originally installed.

I do not think it possible to over-estimate the advantages of storage batteries for the purpose of giving regularity and reliability to a system of distribution. With very sudden fluctuations in the load which are continually taking place, it is almost impossible with dynamos alone to regulate the 'bus pressure so quickly that the pressure throughout the system remains constant. Of course, we have done this for years to the best of our ability, but it has necessitated keeping everything in first-class shape and having the employés of the company on the alert at all times to take care of this question. The uses of the battery very much simplify this problem. Very many times where in the past it was necessary to change the magnetism of the fields of dynamos, it is now necessary to do absolutely nothing, the battery acting as a reservoir, giving out quantities of current without any apparent change in pressure for the time being.

This question of regularity is very closely connected with the one of reliability. To those of us who are identified with central station work there is a great sense of security when we realize that, whatever may happen to the steam plant, we have sufficient battery to carry us over a few minutes of disorder. In our particular case, we have at the present time sufficient battery to run 60,000 lamps for five, ten or fifteen minutes depending upon how great is the emergency. This advantage of the battery may not appeal to an outsider. I do not think they can realize the intense nervous strain to which all connected with the successful detail operation of the station are subjected. If a battery and a steam plant were on a par in all other respects than this, I should personally feel very much inclined to install it for this reason alone.

4. *For the equipment of annex stations.* This is a use to which we have looked forward with great interest, but up to the present time have had no occasion to make the use. There are in every city certain sections located so far from the centres of distribution that it becomes a very serious and expensive matter to reach them with the regular three-wire sytem.

When we realize that it makes very little difference to which end of a tie line a storage battery is connected, we can see at once the special advantage which this type of apparatus gives us. If of such value that it will pay to install them, it is a matter more or less immaterial whether they are installed at the main station or at an annex station connected to the main station by tie lines.

The fixed charges of running a battery room are very small as compared with those of a steam station, and there would not be any very material increase of fixed expense between one large battery located in a central point and half a dozen small ones distributed throughout the city.

Storage batteries, therefore, lend themselves particularly to the location of a "central" station at some convenient point upon the water front, and the building up of small centres of distribution scattered throughout the city, consisting of storage batteries with or without a steam adjunct and connected together possibly, but certainly, each one connected to the central station.

This communication may be considered to have been written upon very narrow lines, and I may say that this was intentional. So much has been written during the past few months upon generalities and upon possible cases which may or may not exist, that it is sometimes valuable to brush these all one side and to confine oneself to some specific cases. This I have tried to do.

Our company has used the first battery 20 months, and one of double its capacity for six months, entirely too short a time to come to any conclusions about the depreciation, but it has given us ample time to satisfy ourselves as to the economic value. It is sufficient for me to say that if a need should arise tomorrow for additional capacity, either at our main station, at either of the annexes or in any new part of the city, within reasonable distance of our centre of distribution, we should consider the question along the lines which I have just indicated. We should eliminate entirely from the discussion the question which has distracted the public mind for so many years and decide it entirely upon its merits, placing the battery side by side and on an equality with other modern and improved apparatus.

Telephone Notes.

Cuthbert, Ga.—Address the mayor regarding the franchise that the city has granted to a telephone company.

Newport, Ark —Newport will soon have a telephone system.

Coudersport, Pa.—A charter has been granted to the Coudersport Telephone Company, with a capital of $3,000.

Janesville, Wis.—A new telephone company is trying to secure a franchise in Janesville.

Rowayton, Conn.—A scheme is on foot in Rowayton to start a local telephone exchange. Edward L. Stevens is at the head of the movement and has the backing of several prominent residents.

Niagara Falls, N. Y.—The Automatic Telephone Co. of Niagara Falls was incorporated with a capital of $75,000.

Nashville, Mich.—Nashville will probably have a new elephone line in the near future.

TELEPHONE PATENTS ISSUED JANUARY 21, 1896.

Automatic Toll-Box for Telephone Pay-Stations. Howard C. Root, Brooklyn, N. Y. (No. 553,361.)

Telephone-Call. James G. Smith, New York. (No. 553,-364.)

Telephone. Samuel A. Dinsmore, Chicago, Ill. (No. 553,452.)

New Corporations.

Brooklyn, N. Y.—The Brooklyn Rapid Transit Co. filed articles of incorporation with the Secretary of State; capital $20,000,000. The purpose of the company is to construct, extend, repair and improve railroads and furnish motive power. Directors, W. C. Bryant, Horace C. Duval, W. W. Goodrich, John D. Kieley, C. L. Rossiter of Brooklyn; James N. Wallace, of New York, and others.

New York City.—Best Electric Light Co., to build and operate conduits for electrical conductors; incorporated. Capital, $5,000. Directors, John A. Gormack, Lester Dex ter and Frederick B. Jacobus, of New York City.

Tarrytown, N. Y.—Tarrytown Electric Railway Co., to build a street surface electric road, four miles long, from Tarrytown to Elmswood. Capital, $50,000. Directors, Robert B. Hopkins, Geo. B. Newton, John C. Barron and Robert Sewell, of Tarrytown; John D. Archibald, Wm. N. Crane, Joseph Eastman, Louis Stone and Wm. Rockefeller, 29 Broadway, New York City.

Fresno, Cal.—Kings River Electric Power Co. has been incorporated by S. F. Earl, J. S. Jones, James Sibley, Chas. D. Wilcox, H. Hammond. Capital stock, $360,000.

Cleveland, Ohio.—Forest City Electric Co. has been incorporated by Wm. B. Cleveland, Robt. N. Lowe, Frank H. Neff, Wm. H. Wherry and W. G. Cleveland. Capital stock, $25,000.

Roanoke, Va.—Virginia Electrical Engineering Co. has been incorporated with Chas. Adamson, president; W. H. Triol, vice-president; G. C. Callahan, secretary. Capital stock, $10,000.

New York, N. Y.—Best Electric Light Co. has been incorporated by John A. Cormack, Lester Dexter and Frederick B. Jacobus, to build and operate conduits for electrical conductors. Capital stock, $5,000.

Fort Valley, Ga.—The Fort Valley Electric Light Co. has been organized with W. H. Harris, president; G. H. Dappey, secretary, and S. F. Neil, manager. To erect plant for operation within sixty days.

New Orleans, La.—J. F. Cohn and M. Ber will organize a $300,000 company to construct a plant, for which they have obtained a franchise.

Leadville, Col.—The Leadville Light Co. has been incorporated. Capital, $150,000. Incorporators, George P. Brown, Charles Boettcher, Charles N. Preddy and A. F. Hunter. The company proposes to operate a general lighting business in Leadville.

Orangeburg, N. Y.—The Electric Chemical Co. Capital $60,000. Directors, E. F. Leber, 51 William street, and Albert Bernhard, both of New York City, and Otto Porsch, of Orangeburg.

Port Jefferson, L. I., N. Y.—The Port Jefferson Electric Light Co.; incorporated. Capital, $7,500. Directors, C. P. Rundall. J. V. N. Bergen and others of Port Jefferson.

Possible Contracts.

Baltimore, Md.—The Edison Electric Illuminating Co., Alfred A. Galsier, of Boston, president, has made two propositions to Mayor Hooper. One of these contemplates constructing conduits for its own lines, or will build a general subway system. It is stated that the city has ample authority to act.

Harrison, N. J.—The Newark People's Light and Power Co. has been awarded contract for erecting new electric light plant.

Washington, D. C.—The Potomac Electric Light and Power Co. will build a large electric light and power plant at once, for which it has obtained a permit.

Columbia, S. C.—The Columbia Canal Co. has decided to construct at once an electric power plant of from 9,000 to 10,000 H. P., to cost about $250,000. The water of the canal is to be utilized to generate electricity.

Baltimore, Md.—The Baltimore Law and Medical University proposes to erect new buildings to cost about $300,000. Address Dr. E. W. Eilau, dean.

Washington, D. C.—Thomas Nelson Page will erect a $100,000 residence. McKim, Meade & White, N. Y., architects.

Louisville, Ky.—It is estimated that the electric road proposed between Louisville and Fairfield will be about 29 miles long and cost $300,000. It will include two power houses.

Brooklyn, N. Y.—It was decided that bonds should be issued to the amount of $750,000, as required by the Board of Education, for the erection of four new school buildings.

Macon, Ga.—The trustees of Mercer University contemtemplate spending $100,000 for new buildings.

Pittsburgh, Pa.—The Allegheny Traction Co. has had completed a preliminary survey for the extension of the Sharpsburg, Etna and Millvale Branch to Clenshaw. It has not been decided when work on the new extension will be commenced.

Richmond, Va.—The residents of Chestnut Hill and Highland Park are contemplating the erection of an electric plant and manufactory.

Plattsburgh, N. Y.—The Plattsburgh Village Trustees granted a franchise to the Plattsburgh Traction Co., giving the company the right to build, operate and maintain an electric street railroad in the village. The company expects to have the road in operation between Plattsburgh and Bluff Point by July.

Mansfield, O.—The Mansfield, Savannah and Wellington Electric Railway was incorporated by Thomas Y. McCroy, Zalmon S. Stockings, Nelson Ozier. They will construct a railroad from Mansfield, through Savannah, Ashland County, to Wellington, in Lorain County. The capital is $100,000.

Brooklyn, N. Y.—The Board of Directors of the Mechanisc Bank, corner of Court and Montague streets, have decided to erect a ten-story building on the site of the present structure.

The Sing Sing Savings Bank have decided to erect a four-story brick structure, to cost 30,000, on the lot on Croton avenue, adjoining the property of the First National Bank.

Philadelphia, Pa.—Plans have been prepared for the erection of a ten-story office building by Thomas Bennett, at the corner of Twelfth and Filbert streets, and filed with the Building Inspection Bureau. Work is to begin as soon as possible.

West Troy, N. Y.—At a meeting of the village trustees of West Troy, the Cohoes City Railway will make application for a franchise to extend its track on 26th street, Third avenue and 19th street, so that connection can be had with the Albany City Railway.

Auburn, N. Y.—The Inter-Urban Electric Railway Co. of Auburn has been granted a franchise by the Common Council. The granting of this franchise will result in c n-necting Skaneateles, Sennett, Throop and Mentz with Auburn.

Buffalo, N. Y.—The Mansion House, corner Main and Exchange streets, will shortly be remodelled. Proprietor Stafford will expend about $75,000 in making the alterations.

Philadelphia, Pa.—Plans have been prepared for the erection of a ten-story office building, at 12th and Filbert streets, for Thomas Bennett. Preliminary drawings were filed with Chief Haddock and the work will be started as soon as possible.

FINANCIAL.

The report of the Edison Electric Illuminating Co., of New York, for the year ending December 31, 1895, shows gross earnings $1,563,778, an increase of $161,767 as compared with 1894; operating expenses, including taxes, $759,472, an increase of $84,602; net earnings, $804,305; increase, $77,164.

The annual report of the Edison Electric Illuminating Co., of Brooklyn, for the year ending December 31, 1895, shows gross receipts $621,149, an increase of $200,075 as compared with 1894; expenses and taxes, $383,707; increase, $149,509; net earnings, $237,442; increase, $50,-566.

The New Orleans Traction Company reports gross earnings for December of $121,372, an increase of $21,307 as compared with the same month of the previous year, and net $56,885, an increase of $7,478.

The report of the American District Telegraph Company for the year ended December 31, 1895, shows: Gross receipts, $554,956; expenses, including construction, $474,-322; net profit, $80,634. The increase in net over 1894 was $12,429. The directors elected at the annual meeting are: James W. Clendenin, D. N. Crouse, Elverton R. Chapman, T. T. Eckert, A. B. Hepburn, George J. Gould, T. Patterson, Thomas C. Platt Henry R. Sheldon and Charles A. Tinker. The directors re-elected Gen. Thomas T. Eckert, president; Charles A. Tinker, vice-president, and Charles S. Shivler, secretary and treasurer.

Trade Notes.

The Benedict & Burnham Mfg. Co., Waterbury, Conn., have just issued a handsomely printed and bound catalogue of their celebrated seamless-drawn brass and copper tubing, bare and insulated electrical wires, brass and copper rivets and burrs, etc., etc. Some valuable tables relating to wires, tubes, plates, etc., are also given.

ELECTRICAL and STREET RAILWAY PATENTS

Issued January 21, 1896.

553,264. Electric Railway. William M. Schlesinger, Philadelphia, Pa., assignor, by mesne assignments, to A. H. Williams, same place. Filed Dec. 21, 1886.

553,266. Car-Fender. Jacob L. Schuman, New York, assignor of one-third to Stuart F. Clark, Kingsbridge, N.Y. Filed July 30, 1895.

553,268. Street-Car Truck. Soren R. Skov, Cleveland, Ohio. Filed Aug. 9, 1894.

553,281. Car-Door. Thomas Eubank, Little Rock, Ark. Filed Mar. 28, 1895.

553,296. Art of Manufacturing Electrical Incandescing Conductors. Jonas W. Aylsworth, Newark, N. J., assignor of one-half to Converse D. Marsh, New York, N. Y. Filed July 27, 1894. Renewed Apr. 6, 1895.

553,297. Car-Truck. William S. G. Baker, Baltimore, Md. Filed June 24, 1893.

553,298. Car-Truck. William S. G. Baker, Baltimore, Md. Filed Oct. 7, 1895.

553,304. Electric Gas-Lighting Apparatus. Henry C. Farquharson, New York, N. Y., assignor to himself and Denise Frank Root, same place. Filed Nov. 4, 1895.

553,320. Electric Register for Sleeping-Car Berths. Stephen C. Skanks, Toronto, Canada, assignor of five-sixths to Walter W. Peay, same place, George Fee, Samuel J. Brown, Oscar Legros and John J. Mackey, North Bay, Canada. Filed June 1, 1895.

553,328. Incandescing Electrical Conductor. Jonas W. Aylsworth, Newark, N. J., assignor of one-half to Converse D. Marsh, New York, N. Y. Filed July 27, 1894. Renewed Aug. 8, 1895.

553,330. Electric Gas-Lighting Apparatus. Henry W. Brinckerhoff, Brooklyn, and Henry C. Farquharson, New York, assignors to said Farquharson and Denise Frank Root, New York, N. Y. Filed Apr. 8, 1895.

553,335. Electric-Arc Lamp. Edward H. Crosby, Boston, Mass., assignor to himself and Otis M. Shaw, same place. Filed May 27, 1895.

553,346. Car-Truck. Calvin W. King, Seymour, Mo., assignor of one-half to W. R. Jackson, S. L. White, J. W. Fuson and J. R. Taggard, same place. Filed Sept. 10, 1894.

553,361. Automatic Toll-Box for Telephone Pay-Stations. Howard C. Root, Brooklyn, N. Y., assignor of one-half to Louis H. Ayres, Philadelphia, Pa. Filed Mar. 22, 1894.

553,364. Telephone-Call. James G. Smith, New York, N. Y., assignor of two-thirds to Robert G. Vassar and Charles B. Smith, same place. Filed Aug. 17, 1895.

553,410. Trolley. William Kaup, Newark, N. J., assignor of one-half to Peter Ulrich, same place. Filed June 7, 1895.

553,446. Magnetic Extracting and Separating Machine. Frank J. Barnard, John C. Moore and John D. Atkinson, Seattle, Wash. Filed Feb. 27, 1895.

553,452. Telephone. Samuel A. Dinsmore, Chicago, Ill. Filed Apr. 22, 1895.

553,464. Apparatus for Electrolyzing Chlorid Solutions, Eugene Hermite, London, England, assignor of two-thirds to Edward James Paterson and Charles Friend Cooper, same place. Filed June 22, 1895.

553,469. Alternating-Current Motor. Maurice Hutin and Maurice Leblanc, Paris, France, assignors to the Société Anonyme pour la Transmission de la Force par l'Electricité, same place. Filed Nov. 17, 1892. Patented in France, Mar. 19, 1890, No. 204,456; in Germany, July 31, 1890, No. 63,446; in Belgium, Jan. 9, 1891, No. 93,-385; in England, Jan. 12, 1891, No. 584; in Italy, Jan. 13, 1891, XXV, 28,966, LVII, 14; in Spain, Mar. 5. 1891, No. 11,690; in Austria-Hungary, June 16, 1891, No. 3,851 and No. 22,375, and in Switzerland, Sept. 12, 1891, No. 3,968.

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JULY 6 TO AND INCLUDING DECEMBER 28, 1895.

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NEW YORK, FEBRUARY 8, 1896.

CONTENTS.

INVISIBLE LIGHT.

Strange as it may seem, there are forms of energy around us that until but a few years ago were completely unknown. The ultra, or dark, rays of the spectrum, the pendulous wave of etheric disturbance proceeding from a Leyden jar, and the manifold quiverings set up by the rapid changes in an electromagnet are now receiving the closest of attention. The marvellous nature of these phenomena have lifted a veil from our eyes and given new power to our hands. The existence of a medium once postulated, now proven, has been the means of enabling us to solve, with a definiteness that defies contradiction, theories of light, heat, magnetism and electricity. The more these forms of energy are examined the more they seem to identify themselves with each other, and all because of the wonderful fact that the medium, the tenuous, yielding and infinitely elastic ether is necessary for their appearance and transmission. What are the glories of a sunrise with its shafts of crimson and gold but the toned undulations of this universal ether? Each substance in this world when permeated with it at a given rate of speed will be endowed with glass-like properties. The visible light, such as we call it, is but a narrow group of ether waves, and glass responds to their touch, carrying the rays of light from other bodies to our eyes because of its simple *transparency*. It would seem, then, that the changes in the ether that escape our notice because of the lacking delicacy of the eye to bring them to our consciousness are imaginably seen by eyes of a greater range of power. The word "transparent" can be applied to certain other substances which to our eye are opaque, yet through which the dark or invisible rays may pass with perfect freedom. It is then but necessary to comprehend the proper meaning of the phenomena of *transparency* to realize that it is but a relative expression. That waves of light may exist and play around the eaves and cornices of a house—rays which we have never seen and in fact can never see—is but a matter of simple proof. To these waves glass is opaque, while the stone wall may be of translucent clearness. Curious as it may seem a lens of hard black rubber may be used for the collection of certain of these stray beams and all the processes through which sunlight may be put will be possible by the use of this opaque lens. In the very midst of Stygian darkness rays of light are streaming forth—heat waves to an innumerable extent undulate through the blackness of night, and in the deepest recesses of mines the dark light, the minute vibrations, pass unnoticed before an incompetent retina. It might have been that our eyes, being sensitive only to the magnetic condition of the ether, would have left us totally unconscious of the golden sunlight and blind to all the varied tints of flowers. Though our eyes fail, and the visual sense is useless for such investigations, the path for the investigator is open. By experiment it may be discovered which of the numerous light waves will penetrate the interior of given substances and a photographic plate—not necessarily sensitized by silver nitrate—will record these impressions and record the visible signs of an invisible light.

HOW OUR INQUIRY COLUMN IS APPRECIATED.

The following is a copy of a letter just received by us which tells an interesting story :

MONMOUTH, ILL., January 21, 1896.

ELECTRICAL AGE PUBLISHING CO., NEW YORK, N. Y.

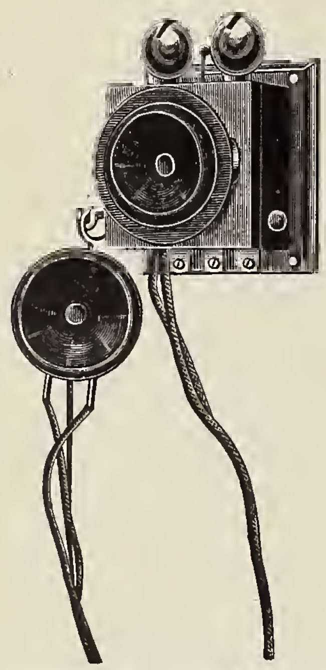
Gentlemen—I take pleasure in availing myself of the Inquiry Column lately started in your paper, and send herewith a question which I would like answered through this department. This department is just what I have been looking for for some time. I think it will be appreciated by most all of your subscribers—by all of the younger and less experienced, at least—and I beg to express my appreciation of your enterprise and accommodation in this as in other lines. It makes the AGE a leader in still another direction. Hoping that you will pardon my intrusion to this extent, I remain yours respectfully,

C. P. LATTA.

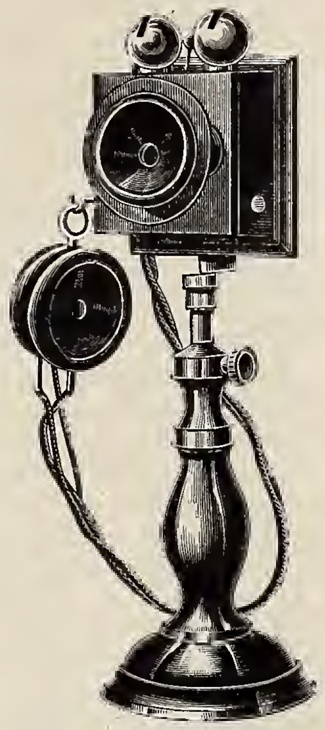
SPEAKING TUBE TELEPHONE.

In these busy days it is of the utmost importance to business men to save time and labor—time first, as labor is a consequence of time. We see everywhere the adoption of time and labor-saving devices, and everything new of this natu re that comes along is eagerly seized, if there is any merit or promise in it.

In a large building, for instance, where different departments of one business are located under the one roof, some quick and reliable method of intercommunication is of great importance. Messengers are too slow; nothing short of a device that will act with the speed of electricity will



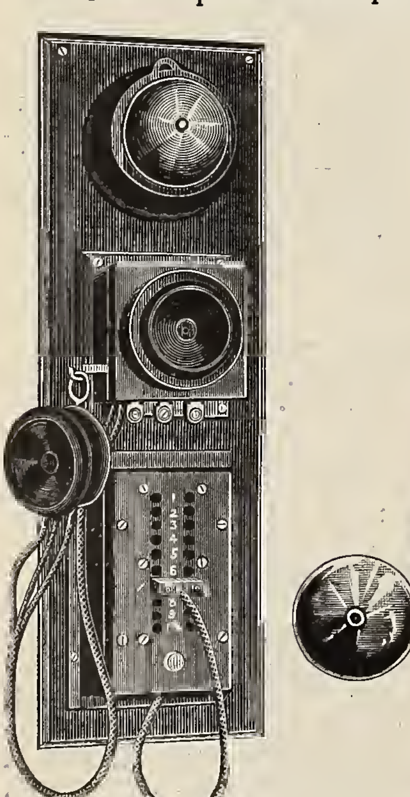
SPEAKING TUBE WALL SET, TO BE USED WITH SYSTEMS A AND B.



SPEAKING TUBE DESK SET.

answer in these times. And the same may be said of hotels; some method of quick and certain communication is a prime necessity in such establishments—some way of telling the office just what you want without having to resort to an imperfect and limited code.

The Metropolitan Telephone and Telegraph Co., of New



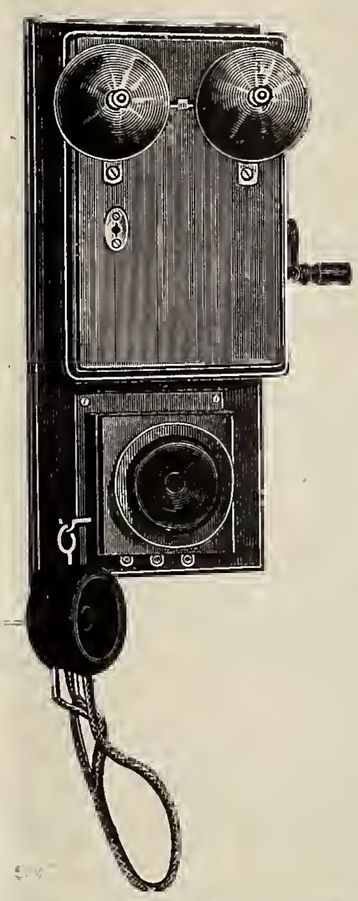
SPEAKING TUBE WALL SET, TO BE USED WITH SYSTEM C.

SPEAKING TUBE DESK SET, TO BE USED WITH SYSTEM C.

York, is now offering its patrons a telephone for just such uses. It takes the place of speaking tubes, call-bell systems, etc., and has the very great advantages of being cheaper to install, more flexible as to distance and direction, and infinitely more satisfactory in working. These instruments are called "Speaking Tube Telephones," to distinguish them from the familiar instrument used for talking over long distances.

In system A there is a central switch with lines radiating from it, each line having one or more stations connected with it, the whole being arranged for intercommunication.

This system is operated in much the same manner as an ordinary telephone exchange, a switch being located at some central point, provided with means for calling and receiving calls from each station and for connecting the several stations with each other. The switch may be located where it can be operated by some person in connection with other work, or if the system is large, the services of a regular operator may be required.



SPEAKING TUBE WALL SET, TO BE USED WITH SYSTEM D.

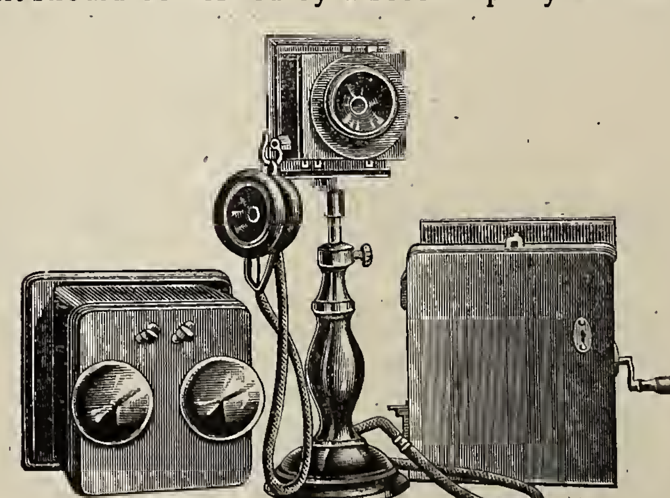
This system (if but one station is connected on each radiating line) secures secrecy between any two stations and provides for independent communication between a number of stations at the same time.

System B provides a switch at a particular office with lines radiating from it, each line having one or more stations connected with it, the whole being arranged for communication to and from the particular office, but not for communication between stations on different lines.

This system is used for transacting business between a particular office and several stations, in cases where it is not required that the stations communicate with each other. A switch is provided in the main office only.

If but one station is connected on each radiating line this system secures secrecy between the main offices and any one of the stations. In system C there is a switch at each station, with means for connecting the instrument at such station with lines extending to each of the other stations.

This system is so arranged that a person at any station can call any other station over a special line and establish the desired counection without the aid of an operator. It does not secure secrecy to such a degree as system A or system B. A switch being located at each station, access may be had to all circuits, whether in use or not; but as the bell at the desired station is the only one operated, when a call is made, secrecy is fairly assured, and interruptions are not likely to occur, unless the use of the same circuit should be desired by a second party and his instru-



SPEAKING TUBE DESK SET, TO BE USED WITH SYSTEM D.

ment be connected for the purpose of making a call. It is possible for parties at several stations to converse independently with each other at the same time.

System D consists of a single circuit connecting two or more stations.

All instruments being connected upon one circuit, no switching apparatus is required. Only two stations can use the line at one time, and there can be no secrecy, as a call made from any station will ring all bells simultaneously.

Systems A and B are especially serviceable for factories, hotels, stores and large apartment and office buildings. System C is perhaps the most convenient and satisfactory when the stations to be connected are not numerous. System D is the most simple and least expensive.

THE COST OF ELECTRIC POWER STATIONS.

The elements of cost which determine the economy of a given type of electric power station are made up of the sum of the interest charges for plant and building, the cost of fuel, repairs and attendance. In general, the more economical plant will cost more for installation than the less economical one; this is subject to limitation from the fact that the more economical engine requires considerably less steam, and consequently it may be supplied by a smaller boiler.

The costs of a steam plant are not exactly proportional to the power required, as the large engines are proportionately cheaper than the small ones, but, considering a plant for a given power, we can obtain figures which will serve as a fair basis of comparison. It will be found that the ordinary simple engine requires very nearly, if not quite, one boiler horse-power for each horse-power of work performed, while the compound engine requires from five-tenths to six tenths as large a boiler and the triple expansion from four-tenths to five-tenths.

This reduction in size of boiler often serves to offset the extra cost of the more economical engine. Thus, as an illustration, applying to engines of about 150 horse-power capacity, a simple automatic engine would cost $12.50 (£2. 10s.) a horse-power; a simple Corliss engine, $15 (£3) a horse-power; a compound automatic, $15 (£3) a horse-power, and a compound Corliss engine, $22 (£4. 8s.) a horse-power. A common tubular boiler with brick setting would cost $15 (£3) per horse-power, and a water-tube boiler, $24 (£4. 16s.).

The cost of buildings is made to vary somewhat in proportion to the room required by the various engines. This is a quantity which will also depend very much upon local conditions and upon the sentiments of the board of directors paying the bills. Stations have been erected in which the cost of the building was fully equal to that of the steam plant. Such a construction can hardly be considered necessary and is not often required.—R. C. Carpenter, in *Cassier's Magazine* for February.

CONFIRMING PROF. ROENTGEN'S DISCOVERY.

Prof. Trowbridge, of Harvard College, last week obtained distinct impressions of various articles by means of "cathode rays" acting through wood and pasteboard, according to the method discovered by Prof. Röentgen, of Wurzburg.

Prof. A. W. Wright, of Yale University, has also been successful in producing images in the same manner, the two professors thereby confirming Prof. Röentgen's discovery.

O'CONNOR'S ELECTRIC RAILWAY SYSTEM.

On January 14, 1896, a patent was issued to Thomas F. O'Connor, of New York, N. Y., on an electric railway system that is a radical departure in design and operation from any hitherto devised.

The invention presents some remarkably novel features. Its object is to provide a method of feeding the motors on each car by separate and individual conductors, each conductor having one end connected to and moving with the car, and the other end connected with the source of power and stationary as respects the movement of the car, the length of the conductor being sufficient to permit the car to move the desired distance from the stationary end of the conductor. In this system the only points of the conductors with which electrical contact is to be made are the two ends. They may, therefore, be fully insulated throughout their entire length, thus avoiding all leakage losses.

The electric conductors are carried on reels at the power house, and as the cars move away from the starting-point, the conductors are unreeled and carry along with the car. When the car returns the slack conductor is reeled up again by the use of proper mechanism. Mr. Connor's specifications provide for several methods of controlling the winding and unwinding of the conductors.

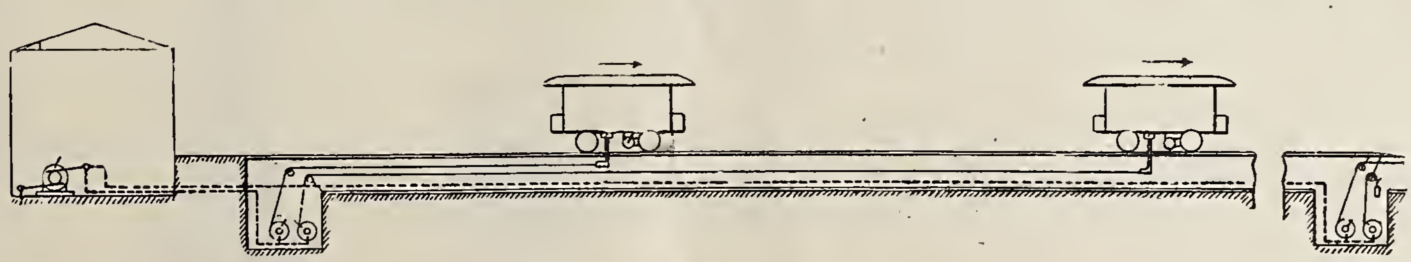


FIG. 1.

The rails may be used as a return, or a cable with duplex conductors for the outgoing and return currents may be used. In practice the service conductor may be quite small, especially when the ground return is used, and with the employment of a high-voltage alternating current in the conductor and a transformer on the car, a very small conductor may be employed.

If the system be applied to a short line, a single reel and

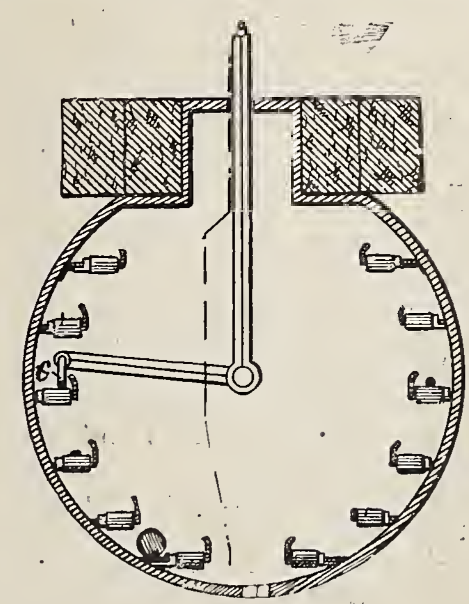


FIG. 2.

conductor for each vehicle may be found sufficient, but in longer lines it will be necessary, or at least desirable, to divide the line into sections and provide reels and conductors for each section. In such a sectioned system a motor-vehicle will be connected to a conductor at the beginning of a section, suitable vaults being provided for operators at such points, and a motor will be fed by this conductor during its travel over that section. At the end of the section this conductor will be detached from the motor and another conductor attached for the next section, and so on to the end of the line. If the conductors are unreeled as the vehicles advance, it will be necessary to return a conductor which has been unreeled and detached to the beginning of the section for use with another vehicle, and for this purpose the reel may be always under tension sufficient to return the conductor after it is detached from the vehicle. This, however, will increase the vehicle load, and it will probably be found preferable to have the reel free to rotate as the conductor is unwound. The operator at the beginning of the section may then be notified when the conductor is released at the end of the section and the conductor then be reeled up. This may readily be provided for by a suitable annunciator system between different stations by which the proper time for reeling up a certain conductor may be indicated at the home station.

The conduit designed for this system embodies some important features as shown in Fig. 2. It is subdivided in such a manner as to provide a separate space or receptacle for each conductor. These receptacles or supports are provided with anti-friction rollers to keep the friction down as low as possible.

It is obvious that a generator may be used at each station—that is, for each station of the line; but this invention provides a system possessing great advantages over those now in use, in that a single power-house may be used for a very long line or a large number of lines, on account of avoiding loss by leakage and the fact that currents of high voltage may be employed, reducing largely the size of the conductors and the cost of copper or other conducting material, which have practically limited the length of line operated from a single power-house in constructions heretofore in use.

Fig. 1 is a diagram of a system showing the power-house and vaults for two sections of the way, with insulated conductors or service cables for one track.

Fig. 2 shows a cross-section of the conduit, with one of the cables connected to a motor arm.

AJAX ARC LAMPS.

As arc lamps are becoming more generally used on low potential circuits the increased demand for such lamps has stimulated inventive minds to great activity in the field of developing a lamp that will be electrically efficient, mechanically simple, neat in artistic design, and capable of filling the exacting demands of a critical public in the point of quality of light and steadiness of burning, and at the same time meet the commercial requirements for a great deal of quality at a low first cost.

One of the recent additions to the already long list of lamps claiming more or less merit in this particular line is the Ajax lamp, manufactured by C. S. Van Nuis, of 136 Liberty street, New York, of which we herewith illustrate a few designs.

Figure 1 illustrates an ornamental brass lamp with opal globe and rich cast brass corona.

Figure 2 illustrates a black Japan case, with round globe and spark arrester, as arranged for out-door use; the resistance coils being mounted upon porcelain insulators on a detachable frame within the tube at the top of the lamp, making the lamp complete in itself and presenting a compact and neat appearance.

Figure 3 illustrates practically the same lamp as shown in Fig. 2, with the spark arrester removed, showing the type of globe-holder adapted for use with these lamps, which is only one of the many little ingenious devices that enter into the make-up of the Ajax lamp, contributing toward a serviceable and artistic whole.

Among the points of superiority claimed for the Ajax lamp are the absence of complicated parts and mechanism. The regulation is accomplished by a single magnet which attracts an armature through a long arc and controls at the further end of a rock-shaft a triple movement which acts upon the rack or upper carbon rod. This triple movement is accomplished in a very ingenious manner by a simply constructed movement frame and brake-wheel, which, we are told, will admit of the lamp striking approximately a normal arc and maintaining a uniform candle-power throughout the life of the carbons. Where one movement alone controls the regulation of a lamp, it may be said that maximum mechanical simplicity has been attained; but it is questionable if any one movement, either electrical or mechanical, can be applied directly to the upper carbon of a lamp, so as to obtain an accurate adjustment of the arc under the varying conditions of a practical working electric circuit. So far as the simplifying of the controlling movement to a single unit is concerned, the designer of the Ajax lamp has reached that goal; but he has deemed it advisable to introduce the more sensitive triple movement into the feed mechanism in order to insure a more gradual and delicate adjustment of the arc than could be obtained by applying a simple magnet movement direct.

Fluctuations of electrical potential are fatal to close regulation in arc lamps governed by too crude a movement between governing magnet and the arc, and it is claimed for the Ajax lamp that a considerable variation in the governing magnet, due to a sudden rise or fall of potential of the circuit supplying the lamps, will affect the


FIG. 1.


FIG. 2.


FIG. 3.

arc but slightly, because such sudden variation is largely compensated for by the three-fold movement above described.

It would appear, therefore, that with a closely regulated circuit the Ajax lamp would feed by inappreciable increments, giving an absolutely steady light, and that with an ever varying potential these fluctuations would be minimized at the arc.

RECENT IMPROVEMENTS IN STORAGE BATTERIES.

A well-attended meeting of the New York Electrical Society was held at Columbia College in the evening of January 29. Mr. Herbert Lloyd, general manager of the Electric Storage Battery Co., of Philadelphia, read a paper on "Recent Improvements in America and Europe in the Storage of Electricity."

Mr. Lloyd briefly referred to the uses of storage batteries in the different European and English cities in electric light and traction work, and described some recent improvements introduced by an English company in the manufacture of plates for traction purposes.

The Madison Avenue storage battery cars in this city were referred to in some detail. This installation has already been referred to in recent issues of The Electrical Age.

An interesting discussion followed the reading of the paper. Mr. Mailloux made some interesting and valuable remarks on the subject of storage batteries, and referred to the great advances made in their manufacture and serviceability.

President J. W. Lieb, Jr., gave an interesting account of the uses of the storage battery by the Edison Electric Illuminating Co., of New York, as an adjunct in electric lighting, and referred especially to the Twelfth street station of that company, where a battery plant now serves a very important purpose. It is proposed to feed the mains in the section of the city below Eighth street by this battery, and shut down the Duane street station at night. The maximum day load of this station is 32,000 amperes at 140 volts, while at night it falls as low as 500 amperes.

THE STANDARD UNDERGROUND CABLE COMPANY.

The annual meeting of the stockholders of the Standard Underground Cable Company was held at the company's office, room 61, Westinghouse Building, Pittsburgh, Pa., January 28, 1896.

Nearly seven-eighths of the capital stock of $1,000,000.00 was represented either in person or by proxy.

The following gentlemen (all of Pittsburgh) were re-elected as directors for the ensuing year, namely: George Westinghouse, Jr., president of the Westinghouse Air Brake Co. and the Westinghouse Elec. & Mfg. Co.; Robert Pitcairn, general agent and superintendent Pennsylvania R. R. Co.; Mark W. Watson, president the Exchange National Bank; J. W. Dalzell, vice-president the Exchange National Bank; Geo. B. Hill, president Pittsburgh, Allegheny and Manchester Street-Railway Co.; John B. Jackson, president Fidelity Title & Trust Co.; James H. Willock, president Second National Bank; John Moorhead, Jr., principal owner of Moorhead Bros. & Co., iron manufacturers; Joseph W. Marsh, the vice-president and general manager of the company.

The report of the Board of Directors showed a total business of nearly $1,000,000.00 for the year 1895. During the year three quarterly dividends of one and one-half per cent. each, and one of two per cent., were declared, and the remainder of the earnings were carried into surplus account, which now stands at $446,869.00, notwithstanding the fact that at the beginning of the year 1895, $100,000.00 was charged off on patent account, and $47,000.co on account of bad debts, doubtful assets, etc, arising in the first twelve years of the company's existence.

The company has been discounting its bills since March last, and closed the year with not one dollar of debt of any kind, except for December bills not subject to discount, or not due for discount on December 31, 1895, and with cash and notes on hand amounting to double the unpaid December bills, to say nothing of accounts receivable considerably exceeding $100,000,00.

Early in the year 1895 a large two-story and basement building (Factory C) was completed and occupied, adjacent to the company's other factories at the corner of Sixteenth street and Allegheny Valley Railroad, in the heart of the manufacturing district of Pittsburgh, and Factory B was remodeled into a three-story and basement building, 55x117 feet, of first-class slow-burning construction. The original Factory A is a large four-story and basement building, and all three factories were equipped during the year with automatic sprinklers, thus greatly reducing insurance premiums, and making a serious fire practically impossible, and obviating any danger of inability to fill orders on account of fire—an extremely important consideration where, in the case of this company, the orders have kept the factory running night and day throughout most of the year.

A large quantity of additional machinery was bought or built and erected in the company's factories during the year, the most important part of which is a moderate-sized, but complete, modern plant for the manufacture of rubber-covered wires and cables, so that this enterprising company is now prepared to furnish wires and cables of any kind a customer may desire, whether insulated with fibre, paper or rubber.

All these improvements, costing between fifty and sixty thousand dollars, were paid for out of current funds, without contracting any debt whatever on account thereof.

The company carried over into January a large amount of unfilled orders, and the orders booked so far in January have been spread over a wide extent of territory. The prospects for a large business in 1896 are considered very good.

This company was the pioneer in the underground cable business, having been organized in 1882, and was for a number of years the only distinctively underground cable company in the United States. For a number of years past it has also been doing a large business in insulated wire of various kinds for overhead use. During the long period of its existence its products have been installed and successfully operated in every state in the union and in many foreign countries, notably Venezuela, Brazil and the Argentine Republic in South America, and in England, India, Australia, China and Japan.

The practicability of operating this company's underground electric cables is no longer contested by any intelligent person, and least of all by the able engineers now occupying the prominent practical positions in the various electrical companies requiring such goods, who have given the matter any investigation, and this company's manufacture of cable is now reduced to as exact a science as is the manufacture of steel rails or I-beams.

The newly elected Board of Directors met on Saturday, February 1, for the purpose of organizing its official staff. The present officers were re-elected, as follows: George Westinghouse, Jr., president; Joseph W. Marsh, vice-president and general manager; F. A. Rinehart, secretary and treasurer; P. H. W. Smith, assistant manager; C. M. Hagen, auditor; W. A. Conner, general superintendent manufacturing department, and Henry W. Fisher, electrician and chemist.

The company's branch offices are ably manned by Geo. L. Wiley, manager of eastern sales department, Times Building, New York; E. W. Dugdale, 336 North Broad street, Philadelphia, Pa., and J. R. Wiley, manager western sales department, The Rookery, Chicago, Ill., at each of which places (as well as in Pittsburgh) experienced construction corps are constantly maintained for the installation of the company's products.

TELEPHONE SERVICE IN NEW YORK.

The wisdom of the introduction, by the Metropolitan Telephone and Telegraph Company, about 18 months ago, of the message rate system of charges for telephone service has been abundantly confirmed by the rapid increase in the number of subscribers.

There were about 10,000 subscribers at the time the new system was adopted, and, under the favorable conditions for small users, the number has rapidly increased until now the company has no less than 14,000 subscribers in New York City. Formerly grounded circuits were the rule; now practically all are metallic circuits, giving every subscriber the means of direct communication from his private instrument with every subscriber in distant cities.

The Metropolitan Telephone and Telegraph Company certainly have exerted themselves to give the best possible service to their customers, and to the public at large, by the establishing of pay stations at convenient places. To do this required, of course, the expenditure of large sums of money, in providing the latest forms of instruments, switchboards, extra wires for metallic circuits, and in scores of other ways, with the one definite object in view—improvement of the service.

It is safe to state that today this company has one of the largest and most efficient telephone plants in the world, and the fact that the service is constantly expanding is proof of the assertion. The operating department is renowned for its efficiency and the intelligence displayed in handling the vast service. Outside of the exchanges themselves the same care and vigilance is exercised over the customers' ends of the wires, and a large corps of competent inspectors is kept constantly employed in watching over and caring for these instruments.

With such an organization there can be but one result and that is—efficiency. The average time of completing a connection is about 30 seconds, but much of this time is chargeable to the subscribers themselves and not to the service.

A little book of hints, distributed by the company recently, gives some practical and timely suggestions in regard to using telephone circuits, which suggestions, if carried out on the part of the customers would save themselves much annoyance at times, and, at the same time, facilitate matters for the operators.

DEPARTMENT OF ELEMENTARY EDUCATION.

BY THE EDITOR.

[*Note.—Any one is invited to ask questions on any point that is not made clear in these articles. Suitable explanations will be cheerfully given under the head of "Answers to Inquiries."*]

(*Continued from Page* 53.)

In the last article we finished the description of burglar alarm circuits; in this we will take up the subject of annunciator circuits, such as are used in hotels, elevators, etc.

An annunciator system is practically a combination of a few or large number of electric bell circuits, each circuit having its own independent indicator or drop on the annunciator.

In a hotel the annunciator is usually located in or near the office, and has as many drops as there are rooms provided with push-buttons. When a guest desires some

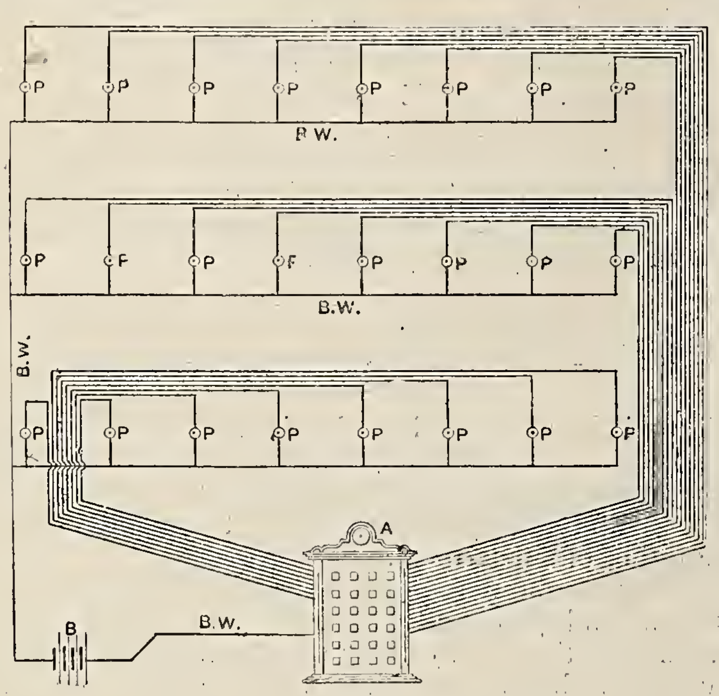


FIG. 15.

special attention he pushes the button in his room; the corresponding indicator on the annunciator drops into view and the bell-boy, or other attendant, knows just where to go in answer to the call.

In installing an annunciator system in a hotel No. 16 copper, double-braided wire should be used for the battery or return wire.

To give us a general idea of how this work is done reference to Fig. 13 in our article on Burglar Alarms, in last issue, will aid us a great deal. If we substitute push-buttons for the window and door represented in that diagram, and suppose that the two push-buttons are in separate rooms, we will have an annunciator system with two drops. We could extend the number of circuits in the same manner to 50, 100, or 500, if necessary, the method of running the wires to each room being the same in all cases.

In Fig. 15 we have a diagram of an annunciator system with 24 connections. The large number of wires are apt to give the idea of great intricacy, but the system is just as simple as the circuits shown in Fig. 13, only there are more of them.

In running the battery wires, they should be laid in such a manner as to be as accessible as possible to make the room connections. They really represent electric mains, which are tapped at various points by the room or side circuits. The push-buttons are usually placed on the casing of the room door, about four feet from the floor.

Next run a No. 16 wire, double braided, from one side of each push button to the main battery wire, making a substantial and careful splice with the latter. From the other terminals of the push-buttons run another No. 16 wire to the annunciator, each wire being connected with an independent drop. From the other terminal of the drop run a wire and splice it to the main wire running from the other pole of the battery. When this is done we have as many circuits as there are indicator drops, each circuit having a push-button and drop independent of all the others, all, however, being operated by the same battery.

In running so many wires as a system of this size requires it is best, if possible, to keep the wires apart as far as practicable when they approach and leave the annunciator, or, at any other point where they are liable to be bunched. Under *all* circumstances avoid bunching electric wires as far as possible. It invites trouble by so doing, and in case of trouble on any one circuit it is very difficult to find the defective wire. Therefore it is always advisable to keep each wire away from the rest.

Wires should never be drawn taut and fastened, because they would likely be broken if the building should settle afterwards. Better have a little slack.

(*To be Continued.*)

Personal.—J. L Zeidler, of the Safety Arc-Lamp Hanger and Improvement Co., St. Joseph, Mo., was in town last week, as was also Mr. H. E. Webb, of the Solar Carbon and Manufacturing Co., Pittsburgh, Pa.

ANOTHER STREET RAILROAD NOT NEEDED IN BUFFALO.

The State Board of Railroad Commissioners has rendered its decision on the application of the Buffalo Traction Company for a certificate of necessity and convenience. They refused to grant the application on the ground that public convenience and necessity do not require the construction of the proposed railroad.

ELECTRICITY ON THE NEW YORK ELEVATED ROADS.

It is reported that an experiment in electric traction is to be tried on the Thirty-fourth street branch of the Manhattan Railway and that a contract has been signed with the Electric Storage Battery Company, of Philadelphia, for the equipment of an engine with the storage system. A novel feature of the trial will be a new method of supplying the cells with electricity.

Instead of doing this at a central station it is the purpose to take the electricity from a third rail beween the tracks, thereby causing a great saving, it is claimed, in power. The electricity is to be generated by dynamos furnished by the General Electric Company. The Electric Storage Battery Company claims that this combined method of traction is seven per cent. cheaper than the present motive power of the elevated railroads—in other words, that there would be a saving in coal and other operating expenses of more than a million dollars a year.

From conferences with different electric companies, the Manhattan officers conclude that it would cost from $6,000,000 to $8,000,000 to change the motive power from steam to electricity. This would make an additional interest charge of $240,000 to $320,000 per annum, in case four per cent. bonds were issued to meet the cost.

If the claim of the storage company is correct, there would be a net saving of $700,000 a year.

A Very Common Hat.—"To look swell about the head wear Smith & Jones' hats."

The above is an illustration of the Metropolitan Realty Building, 214-218 William street and 18-20 Rose street, New York. This building is the strongest and best fitted-up fireproof building ever constructed in the city for manufacturing purposes. It is 14 stories high, and has a complete electric light plant, and is besides, equipped with the Western Electric Company's system of electric clocks on all the floors. Abundant fire appliances are provided. Several electrical concerns occupy quarters in this fine building.

MONARCH INSULATING PAINT.

Elmer P. Morris is in the city and is pushing Monarch Insulating Paint, which is manufactured by the Bradford Belting Company, of Cincinnati, Ohio. This paint is water, acid and practically fire-proof, and is used for armatures, fields, switchboards, conduits, iron and wood poles, connections, mouldings, cut-out boxes, etc., etc. It is not affected by extremes of climate and temperature, and is said to last longer than any other insulating paint. The Monarch Insulating Paint has no equal as a wood preservative.

CARING FOR SWITCH-TENDERS.

The Brooklyn Board of Aldermen have given authority to the Nassau Electric Railroad Co. to place temporary sentry-boxes along its lines for the protection of switch-tenders in stormy weather.

PROPOSALS FOR LIGHTING.

Sealed bids will be received by Sumner T. Bisbee, clerk of Council of the city of Keokuk, Iowa, until 12 o'clock noon of Friday, February 21, 1896, for lighting the city of Keokuk with 140, more or less, arc lights, in accordance with specifications now on file with, and copies of which can be had of Sumner T. Bisbee, clerk of Council of Keokuk, Iowa.

Said contract to be for the term of five (5) years from and after May 3, 1896.

Said bids to be opened and acted upon at a special meeting of the council to be held Friday, February 21, 1896, at 7:30 p. m.

The council reserves the right to reject any or all bids.

Sumner T. Bisbee, Clerk of Council.

Keokuk, Iowa, January 25, 1896.

New Castle, Col.—Sealed proposals will be received by the trustees of the town of Newcastle, Col., February 24, for the furnishing of an electric light and power plant; said plant to furnish light for 600 incandescent lamps, more or less, and 50 arc lamps, more or less, with steam-engine and boiler of sufficient capacity to operate a plant one-third larger than named above.

F. D. Pierce, Recorder.

Telephone Notes.

Cuthbert, Ga.—John D. Gunn has received a telephone franchise.

Paris, Tenn.—Cumberland Telephone Co. has received a telephone franchise.

Warren, O.—A company is being formed for the purpose of building and operating a telephone line between Warren, Cortland, Burg Hill, Kinsman, Orangeville and Greenville, Pa.

Red Hook, N. Y.—Red Hook Telephone Co. of Red Hook, to operate a telephone line from Barrytown to Red Hook, Upper Red Hook, Annandale and Rhinebeck. Capital, $5,000. Directors: Peter H. Troy, D O'Connell of Barrytown, John Troy, Daniel T. Wilbur of Red Hook and Samuel Krupley of Poughkeepsie.

Kingwood, W. Va—The Kingwood & Dunkard Bottom Telephone Co., organized to construct a telephone line from Kingwood to I. Parsons Martin's residence on Dunkard Bottom, about three and a half miles from Kingwood. Col. A. F. Martin, president; I. P. Martin, secretary and treasurer; Nathan Wilson, superintendent. The line will be constructed at once.

Rosendale, N. Y.—The Citizens' Standard Telephone Co. will probably complete the extension of their line from Rosendale to High Falls and be in communication with the latter place.

Fall River, Mass.—It is rumored that the American Printing Telephone Co. will shortly ask for a franchise. It is further rumored that the company will agree to furnish private lines for three-quarters the sum the public ones cost under the present system.

Menominee, Mich.—The City Council passed an ordinance granting a franchise to local capitalists to erect a new telephone system.

Alpha, Ill.—Alpha is to have another telephone line, The new line is to connect Kewanee, Galva, Cambridge, Orion, Opheim, Andover. Lynn and Alpha.

Winchester, Ky.—Winchester will soon have a first-class telephone system.

Fairview, Ky.—Fairview is to have a telephone connection with Hopkinsville or Pembroke.

TELEPHONE PATENTS ISSUED JANUARY 28, 1896.

Composite Telegraphic and Telephonic Transmission. Edward E. Backus, New York, N. Y. (No. 553,605.)

Antiseptic Diaphragm for Telephones. Emil Weschcke, San Francisco, Cal. (No. 553,633.)

New Corporations.

Little Rock, Ark.—Little Rock Ice and Electric Company, incorporated by Faucette Bros. Capital stock, $100,000.

Richmond, Va.—American Telautograph Company has been incorporated by J. C. Mahen, W. H. Eckert, A. S. Buford and J. T. Ellyson. Capital stock, $50,000. To conduct a telautograph and telegraph business.

Washington, D. C.—The Potomac Light and Power Company has been incorporated for the sale of electrical current and electrical appliances of all kinds. Capital stock, $100,000, with the privilege to increase to $500,000.

Orangeburgh, N. Y.—Electrical Chemical Company has been incorporated by E. F. Leber, Albert Bernhard and Otto Porsch. Capital stock, $60,000.

Boston, Mass.—New England Electric Supply Company has been incorporated with Henry Cole, president; Bracey Curtis, treasurer; John S. Keenan and Henry N. West. Capital stock, $10,000.

Chicago, Ill.—Chicago Arc Light Improvement Company. Capital, $100,000. Incorporators, Paul Brown, 505-87 Washington street; Wm. G. Adams and John N. Miller.

Washington, D. C.—The Potomac Sefler Electromagnetic Railway Company has been incorporated by F. J. Patterson, George W. Mills, V. Griffin, M. L. Patterson and L. E. Patterson, all of Chicago; to build railways, boulevards, etc.

Port Jefferson, Suffolk County, N. Y.—The Port Jefferson Electric Light Company has been incorporated by J. V. N. Bergen, E M. Davis, Chas. P. Randall, C. F. Purick, W. T. Wheeler; to manufacture and use electricity. Capital stock, $7,500.

New Brighton, S. I., N. Y.—The New York and Staten Island Traction Company was incorporated with a capital of $2,500,000. The company is organized to distribute power to corporations, firms, etc., and to build railroads. Directors, Charles L. Horton, Arthur D. Chandler, Francis P. Lowry and William R. Morrison, of New York.

Templeton, Mass.—The Templeton Street Railway Company has been incorporated by Isaac Baum, S. F. Greenwood, John F. Chamberlain, C. E. Ingalls. Capital stock, $50,000.

Jersey City, N. J.—The Crossley & L'Hommedieu Heating Company has been incorporated by John K. L'Hommedieu, Seward Baker, Charles Crossley; to erect and supply all kinds of electric heating and lighting apparatus, etc. Capital stock, $50,000.

Tarrytown, N. Y.—Tarrytown Electric Railway Company has been incorporated by Robert E. Hopkins, George B Newton, John C. Barron and Robert Sewell, of Tarrytown; John D. Archibald, William N. Crane, Joseph Eastman, Louis Stone and William Rockefeller, of New York; to build a street surface electric road four miles long, from Tarrytown to Elmwood, Westchester county. Capital stock, $50,000.

Trenton, N. J.—Citizens' Electric Light Company has been incorporated by P. J. Berry, Edward A. Fisher, George Hildebrecht, John M. Burgner. Capital stock, $100,000.

Possible Contracts.

Quincy, Fla.—The Quincy Electric Light, Heat and Power Co. wants an electric light plant with a capacity of six hundred 16-c.-p. incandescent lights and thirty or forty 1,200-c.-p. arc lights; also a power plant for above of from 75 to 100-H. P. The above plant is to be operated by water-power, four and one-half miles from the town.

Richmond, Va.—The Fairmount Traction Co. has asked the legislature for a franchise to construct an electric road in Richmond and Henrico County.

Savannah, Ga.—Middleton & Freeman, 68 Bay street, are looking around for a dynamo to develop 2,200 to 2,300 amperes at 60 volts for twenty-four hours per day.

Brunswick, Ga.—J. D. Mitchell is contemplating the erection of a theatre, to cost $30,000.

Arnprior, Ont.—Mr. Bolfield, of Eganville, is seeking a franchise for electric lighting. The power house will be located on M. Havey's property.

Cornwall, Ont.—The contract for the construction of the electric railway has been signed by Messrs. Hooper and Starr, of Montreal. The franchise was held by W. R. Hitchcock.

Morrisburg, Ont.—The village council is considering the question of putting in an electric light plant.

Ridgeway, Ont.—The Crystal Beach Improvement Co. proposes constructing two miles of electric railway from Crystal Beach to Ridgeway.

Lockport, N. Y.—Alderman Huston offered a resolution that the city attorney prepare a bill, to be submitted to the legislature, allowing the city to issue $40,000 worth of bonds, for the purpose of establishing a municipal light plant. Referred.

Brooklyn, N. Y.—The old post-office building is being torn down and it is the intention of the Brooklyn Trust Co. to erect store buildings in its stead.

Jersey City, N. J.—The Erie Railroad Co. will expend $1,000,000 in erecting new depots at Middletown and at Paterson, N. J.

Windsor Mills, Que.—The works of the Canada Paper Co. are shortly to be operated by electricity. Power from the St. Francis River, one mile distant, will be transmitted to the mills. The factory will also be lighted by electricity and an electric railway will be constructed from the power house to the mills. The total amount of power to be transmitted is about 1,000 H. P. The work is in the hands of Mr. Geo. White-Fraser, electrical engineer, Toronto.

Minneapolis, Minn.—The Minneapolis and St. Louis road is planning to operate its lines between Minneapolis and Lake Minnetonka by electricity. Power houses will be erected at each terminal and the electricity generated will also be used in running a fleet of naphtha yachts. The distance of the road is eighteen miles. General office, Minneapolis.

Elizabeth, N. J.—The Board of Education of Elizabeth has decided to equip the new school with electric clocks and bells, with telephones in each room.

Atlanta, Ga.—At a meeting of the G. A. R. of Fitzgerald, it was unanimously decided to build a new $10,000 building.

New York City.—Cady, Berg & See, 31 East 17th street, architects, have filed plans for the erection of a new five-story brick building on the northwest corner of Amsterdam avenue and 112th street, which will be devoted to the harboring of old men and aged couples who are unable to care for themselves. Estimated cost, $140,000.

Mamaroneck, N. Y.—The New York, Elmsford and White Plains Railroad Co. has obtained a franchise to construct an electric railroad in Mamaroneck avenue, in Mamaroneck. This road will connect with the Elmsford extension.

Pulteney, N. Y.—Pulteney citizens want the electric railroad from Bath to Hammondsport extended into their town.

Milton, N. Y.—C. M. Woolsey has commenced excavating for a new building on Main street. The building will be used for stores and offices.

Reading, Pa.—The committee of the Masonic fraternity of this city have concluded the purchase of a block of property on North Fifth street, upon which it is proposed to erect a Masonic Temple, which is to cost about $100,000.

Quincy, Mass.—A syndicate has purchased the Panton estate and immense blocks will be built, which, besides stores and office rooms, will contain a large hall for the holding of meetings, assemblies, etc.

Bangor, Me.—The local Odd Fellows' lodges contemplate the erection of a fine brick and stone building, to cost about $20,000.

Northampton, Mass.—The Father Matthew Temperance Society will build a three-story brick building, to cost $10,000, on the site of the present quarters on Center street.

Pittsburgh, Pa.—The Board of Directors of the Exposition Society and the central board of the North American Saengerbund met and held a conference on plans for the construction of a music hall for the national saengerfest, to be held June 8. The total cost will approximate $25,000, and Joseph Stillberg is the architect.

Trade Notes.

The Storage Battery Supply Co., No. 239 East 27th street, New York, is doing a good business in its line. This concern makes a specialty of renting and charging storage batteries and delivering the same to private houses, offices, hotels, etc., for use in operating phonographs, fan motors, dental and surgical instruments, sewing machines, automaton pianos, decorative effects, etc. This company maintains the batteries, calls for them when they are discharged, recharges and redelivers them to the customer for a reasonable charge.

Mr. A. D. Dorman, Havemeyer Building, New York, is the eastern manager of the Adams-Bagnall Electric Co., of Cleveland, Ohio. Mr. Dorman handles series constant-potential and alternating arc lamps and all kinds of incandescent lamps. He is an old Brush man, having been with that company for eight years. Mr. Dorman is assisted by W. J. Clarke.

ELECTRICAL and STREET RAILWAY PATENTS

Issued January 28, 1896.

553,522. Car-Fender. Michael F. Flynn, Stamford, Conn. Filed April 3, 1895.

553,524. Car-Fender. Louis Hachenberg, New York, N. Y. Filed April 18, 1895.

553,528. Lightning Arrester. Ernst G. W. C. Hoffmann, Charlottenburg, Germany, assignor to the Siemens & Halske Electric Company of America, Chicago, Ill. Filed September 3, 1895.

553,529. Method of Electrical Propulsion for Street or Other Cars. John Jackson, Clinton, Iowa. Filed November 10, 1893.

553,535. Telegraph-Repeater. Benjamin F. Merritt, Newark, N. J., assignor to the Consolidated Telegraph and News Company, New York, N. Y. Filed May 20, 1895.

553,538. Rheostat. William H. Morgan, Alliance, Ohio, assignor of three-fourths to Thomas R. Morgan, Sr., Thomas R. Morgan, Jr., and John R. Morgan, same place. Filed November 21, 1891.

553,541. Automatic Railway-Gate. George A. Reynolds, Utica, N. Y., assignor to the Reynolds Railway Gate Company, of Maine. Filed Feb. 5, 1894.

553,549. Car-Fender. Charles M. Wilcox, Newark, N. J. Filed May 17, 1895.

553,552. Electric-Railway Conduit. Alexander Beck, Atlanta, Ga. Filed November 2, 1894.

553,557. Armature for Electric Machines. Richard M. Gardner, Chicago, Ill. Filed May 27, 1895.

553,572. Dental Light and Heater. Frank H. Stafford, Chicago, Ill. Filed May 27, 1895.

553,591. Fender for Cars. Robert C. McGuire, Pittsburgh, Pa., assignor of two-thirds to Harry S. Brickell and Thomas F. Kirk, Jr., same place. Filed August 28, 1894.

553,596. Secondary Battery. Paul F. Ribbe, Berlin, Germany. Filed July 10, 1895.

553,605. Composite Telegraphic and Telephonic Transmission. Edward E. Backus, New York, N. Y., assignor to the American Telephone and Telegraph Company, of New York. Filed June 17, 1895.

553,632. Automatic Coal-Recording System for Railways. Frank A. Walters, Denver, Colo. Filed May 23, 1895.

553,633. Antiseptic Diaphragm for Telephones. Emil Weschcke, San Francisco, assignor of one-sixteenth to George W. Van Alstine, Los Angeles, Cal. Filed May 9, 1895.

553,635. Underground-Trolley System. Nathan H. Anspach, Chicago, Ill. Filed August 20, 1895.

553,636. Low-Water Alarm. Oscar J. Backus, San Francisco, Cal. Filed May 9, 1895.

553,637. Electric-Arc Lamp. Ernest J. Bagnall and George Arnold, Cleveland, Ohio, assignors to the Adams-Bagnall Electric Company, same place. Filed October 2, 1895.

553,642. Register. Thomas B. Dixon, Henderson, Ky. Filed August 20, 1894.

553,664. Street-Car Fender. Hugh L. Bedford, Bailey, Tenn. Filed June 11, 1895.

553,673. Incandescent Lamp. Henry Green, Hartford, Conn., assignor to the Ætna Electric Company, same place. Filed April 16, 1895.

553,674. Process of Producing Paper Elbows. Edwin T. Greenfield, New York, N. Y., assignor, by mesne assignments, to the Interior Conduit and Insulation Company. Filed June 5, 1890.

553,675. Electromagnet. Charles D. Haskins, Brooklyn, N. Y., assignor to the Western Electric Company, Chicago, Ill. Filed May 18, 1889.

553,697. Electric-Arc Lamp. Hans O. Swoboda, New York, and Erwin Lavens, Brooklyn, N. Y., assignors to the General Incandescent Arc Light Company, of New York. Filed September 6, 1894.

553,719. Electric Battery. Johan W. T. Olan, New York, N. Y. Filed August 5, 1892.

553,730. Electric Switch. John C. Fagan, Watertown, N. Y. Filed May 6, 1895.

553,732. Electrolytic Bath and Appliance. James H. George, New York, N. Y. Filed May 8, 1895.

553,733. Automatic Repeating Railroad-Signal. Robert H. Innes, San Antonio, Tex. Filed March 30, 1895.

553,736. Electric-Railway System. John F. Page, Chewacla, Ala. Filed June 28, 1895.

553,754. Fender for Cars. John B. Kendall, Washington, D. C. Filed November 21, 1894.

553,799. Electric Railway. Moses L. Wood, U. S. Navy. Filed September 12, 1895.

553,819. Control System for Electric Motors. Gaston Sautter, Paris, and Joseph M. L. Salvatier and Charles E. De Lagabbe, La Seyne, assignors to Sautter, Harlé & Co., Paris, France. Filed September 21, 1893. Patented in France Oct. 20, 1892, No. 225,049, and in England July 27, 1893, No. 14,486.

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CONTENTS.

WHAT SHALL IT BE NAMED?

Pictures produced by the process discovered by Prof. Roentgen are called by various names. Several distinctive titles have been suggested, such as "Electrograph," "Skotograph," "Shadowgraph," etc. If there is any possible way to gain common consent for the adoption of a proper word it should be done. Above all do not let a name come into use that is not based on reason, and is meaningless in itself. A denizen of the Fort Ward could coin a word, but don't let him.

THE BERLINER TELEPHONE PATENT.

A motion was made in the Supreme Court of the United States, Washington, on February 3, by Attorney-General Harmon, as special counsel for the United States, to advance the Berliner telephone patent case for an early argument in next term of the court, and Messrs. Fish and Storrow said they would not oppose it. The brief in support of the motion sets out that the suit is brought to obtain the repeal of the patent granted to the American Bell Telephone Company, as assignee of Emil Berliner, the alleged inventor, on the ground that the application for it filed in 1877 was not issued until 1891, it being unnecessarily delayed in the Patent Office, the assignee promoting said delay for its own interest and in fraud of the rights of the public and in violation of its duty to the public; that said Berliner patent practically controls the art of telephony, and having been thus delayed until 1891 (the patent of Alexander Graham Bell for the speaking telephone expiring in 1893), operates to prolong the control of the art of telephony for fifteen years beyond the time when, by the expiration of the said Bell patent, such control should rightfully cease; that said patent was granted by the Commissioner of Patents without authority of law, being for the same invention for which patent had been granted to the same applicant in November, 1880.

"If the United States," the brief says, "are right in their contention that the Berliner patent, for the reasons stated, ought to be repealed, it is of great importance to the public that the repeal should not be unnecessarily delayed."

PROF. ROENTGEN'S GREAT DISCOVERY.

One of the most remarkable features of Prof. Roentgen's discovery is the suddenness with which it revealed to our senses such great possibilities. How thin a veil hid these wonders from us, and how puny and insignificant man seems when we think what little things block his progress! Another interesting fact connected with the discovery is the ease with which it can be repeated; every one having the simple means at hand has already produced cathode pictures with more or less successful results, thus demonstrating the simplicity of the tremendously important fact that was for so long hidden from our senses. To give a detailed account of the work of the different experimenters throughout the United States would fill a book, but wonderful things are being done in the direction of practical application. Mr. Edison has taken up the subject in earnest for the purpose of determining the best degree of exhaustion of the tubes, the permeability of different substances to the rays, and other such important facts that will be necessary to know in order to premise results. Any one with the simple apparatus can make a picture by the new process, but what should be known is, what are the best conditions for the work under varying circumstances. Prof. M. I. Pupin is doing some excellent work, and took a picture a few days ago actually showing the curvature of the lens of an eyeglass, and proving the opacity of glass to the cathode rays. Mr. Edison proposes to photograph the brain of a person—at least he is going to try to do so. Other experimenters have photographed different portions of the human anatomy with sufficient success to promise wonderful results in this line. In a letter from Prof. H. S. Carhart, of the Ann Arbor University, that gentleman informs us that he had, at the date of writing—February 8—"succeeded in getting one pretty good photograph. Prof. Trowbridge, of Harvard; Prof. Magie, of Princeton; Prof. Wright, of Yale, and many others have experimented with the new rays and produced pictures, and the good work is being developed in numberless places. We look for some wonderful revelations and possibly other discoveries as a result of Prof. Roentgen's work, and it is simply useless to predict where the thing will end.

TEST OF MOTOR CARS ON THE BROOKLYN BRIDGE.

The first official exhibition of electricity as applied to the switching of the cars on the Brooklyn Bridge was made February 8, at 11 A. M., in the presence of President Howell, Vice-President J. Seaver Page and Trustees Keeney and Henriques. The motor car was coupled to three of the ordinary passenger cars, and the complete train of four cars was switched by the motors from the incoming to the outgoing platforms and thence to the cable sheaves several times. The car was then taken over the complete Bridge circuit twice. Complete satisfaction was expressed by the President and by Chief-engineer C. C. Martin at the manner in which the work was performed.

The use of electricity in place of steam for switching the cars at either end of the Brooklyn Bridge has been recognized as the only suitable method ever since the electric railway motor became a practical fact. But not until the motor had been adapted to heavy train service and had proved successful on the West Side Elevated Road at Chicago, the Nantasket Beach Division of the New York, New Haven & Hartford R. R., and on the Baltimore and Ohio main line, did its employment in the Bridge service become possible.

To enable the trustees and the engineer the better to judge of the advantages which electric power might offer over the steam power hitherto employed for switching service, bids were called for the proposed electrical equipment. Consideration was only given, however, to two propositions, that of the General Electric Company, which had already fully developed apparatus applicable to heavy electrical traction work, and which equipped the three roads above mentioned, and that of the Westinghouse Company. The latter concern declined, but the General Electric Company responded, offering to fully equip one car, operate it for thirty days and at the end of that time, if the result were not satisfactory, to restore the car to its original condition and bear the cost of the experiment.

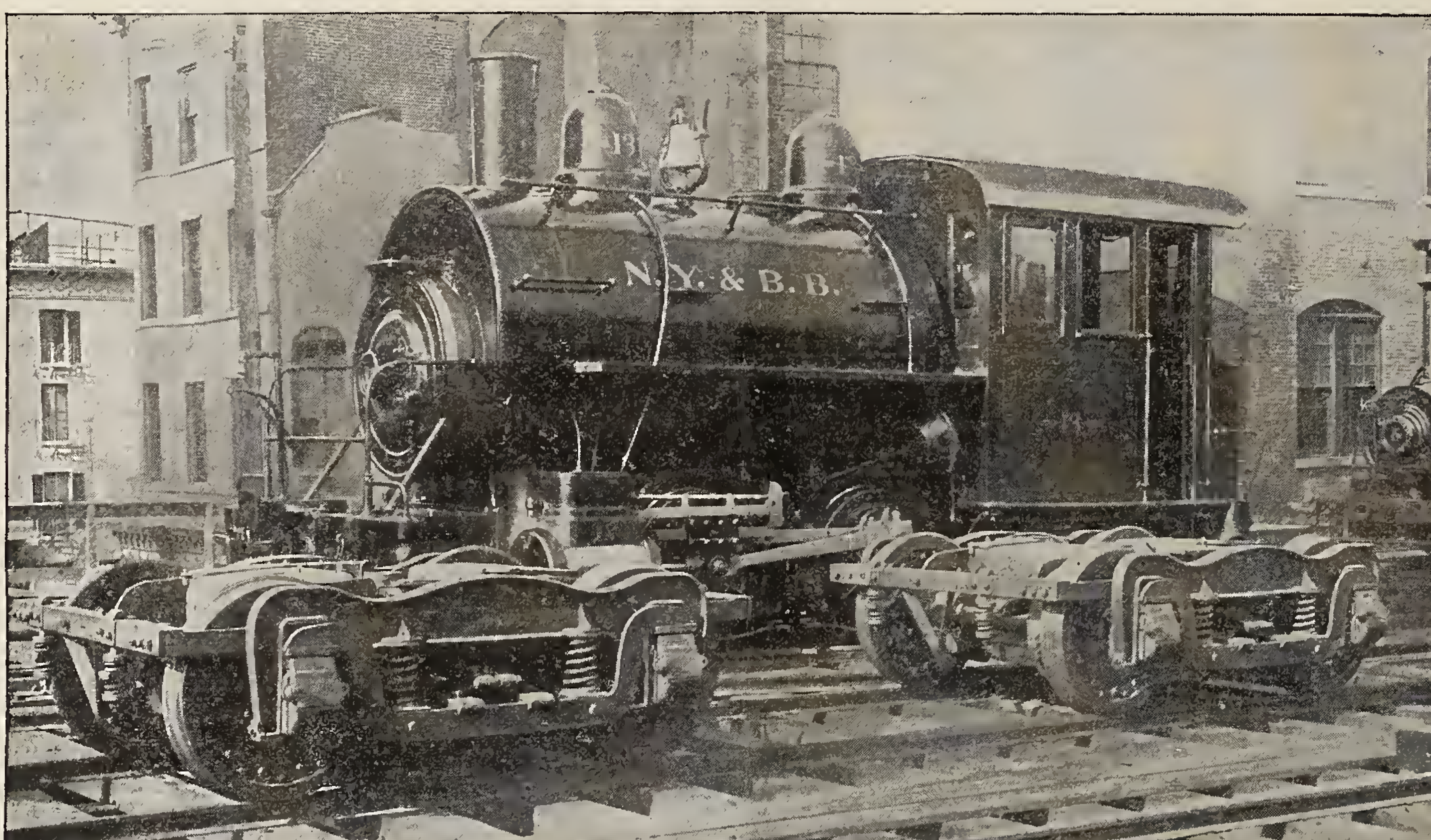
If the general plan adopted at first prove economical as well as satisfactory, a certain number of cars will be equipped with four motors, one on each axle. These cars are to be known as motor cars, and each will remain with its own train at all times, switching it from the incoming to the outgoing tracks and pulling or pushing it over the tilting sheaves, when the grips will take up the cable and the motors cease work. Should the grips slip while the train is mounting the 3.73 grade, the motors can come again into requisition and assist the trains over the summit. Moreover, during the early morning hours when traffic has become light and the cable is no longer running the trains can be operated by motor cars as they are now by the locomotives. The eventual outcome will probably be the exclusive operation of the Bridge Railroad by these motor cars. Meanwhile they will switch the trains, and as each train is equipped with its own switching power—the motor car— all the interference which the steam locomotives have hitherto placed in the way of the incoming and outgoing trains will be done away with and the complexity of the switching be greatly reduced.

Car No. 76, one of the regular passenger cars of the Brooklyn Bridge, has been selected to receive the first electrical equipment. All the apparatus, with the exception of the controlling handles and circuit breakers, will be placed out of sight beneath the floor of the car. The ordinary light Pullman trucks on which it has hitherto run and the cable grip mechanism have been removed. Heavier trucks were necessary to carry the motors. These were supplied by the McGuire Company of Chicago and combine the best features of the passenger and locomotive truck.

The general character of the motor equipment is similar to that in use on the Chicago Elevated and Nantasket Beach roads above mentioned. The motors are known as the G. E. 1200, from the fact that under normal conditions each will exert a horizontal effort of 1200 lbs., when mounted on a 33-inch wheel. Four of those motors are employed, one to each axle, or two to each truck. They are completely incased and are water and dust-tight. The armatures are of the well-known iron-clad type, the windings being sunk into slots in the armature core. The Eickemeyer winding is used on the armature. By this method the crossing of two wires of large difference of potential is avoided.

The insulation is substantial and each segment of the commutator is of hard drawn copper. The armature is mounted on a sleeve keyed to the shaft, which may be withdrawn without interfering with the armature structure. The field frame is of cast steel. The ratio of reduction between the armature shaft pinion and the wheel gear is 3.5 to 1.

Each motor weighs about 3,000 lbs. With this equipment and the regular train a speed of about 15 miles an hour may be obtained. Each motor is suspended on the truck from two trunnions in the upper field set in two bars, the outer ends of the bar resting on elliptical springs. The axle is thus relieved of nearly all the weight of the motor.



BROOKLYN BRIDGE MOTOR CARS—SIDE VIEW OF MOTOR TRUCKS.

At the base of each motor, facing the ends of the car, is a small roller which depresses the cable and allows it to pass the motor without injury, while a long iron bar runs beneath the truck and depresses the tilting sheaves, preventing them from striking the motor.

The operation of the motors is controlled by series-parallel controllers of the L 4 type, which have given such general satisfaction on the Chicago roads.

The indicating dial of the controller is placed at the top of the platform rail and is lettered "series," "multiple," and "off," showing exactly the position of the controller itself. The reversing handle is a jointed handle, which can be placed on or taken off the reversing switch spindle only when the controller handle points to the "off" position, showing that there is no current in the motors at that moment. The controller itself has no effect until the long arm of this jointed handle is dropped into the "forward" or "reversing" notches in the reversing handle plate. There are two controllers, each operated from its own platform and either controller will operate the four motors or any two ot them, as may be desired.

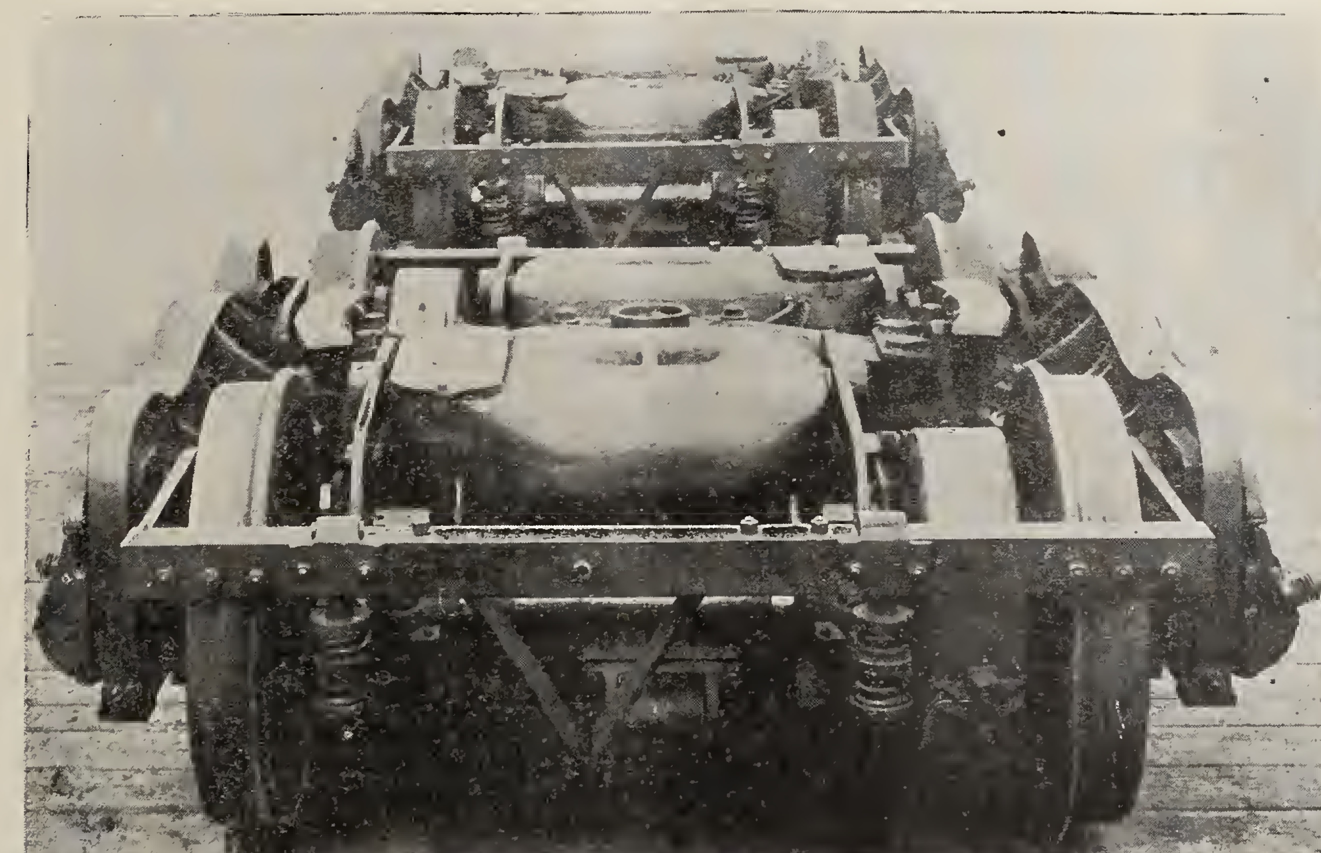
The resistances as well as the magnetic cut-outs are also placed beneath the car floor. Beneath each hood of the car is an automatic circuit breaker, placed within easy reach of the motorman. The operation of this device is instantaneous and is an effectual safeguard against any accident to the motor. These circuit breakers take the place of the main circuit hood switches, but are wired in multple with each other instead of in series. To guard against any possibility of one being closed while the motorman is at the other end of the car and desires to open his main circuit, only one handle is provided. The handle cannot be taken off without opening the circuit breaker, and when removed the circuit is locked open. As the motorman must take the controller and circuit breaker handles with him when changing ends, all danger of complication is avoided.

The car is equipped with 12 electric heaters, manufactured by the Consolidated Car Heating Company, of Albany, N. Y.

The collector which will take the current from the overhead wire is a diamond shaped frame of metal set longitudinally upon the roof of the car and carrying at right angles a bar, in the centre of which is a roller. The arms are wide enough to preclude any possibility of missing contact. The diamond frame is depressible and expansible on the principle of the pantograph, allowing a play up and down to conform to the varying heights of the overhead wire. With this collector the trouble of reversing is entirely done away with.

The power to run the car will be taken from the overhead wire already in position supplying current to the electric lights in the cars. The extra current, however, will be supplied from Fulton street feeder of the Kent avenue station of the Brooklyn City Railway, the return wire being connected to the rails of the surface road.

In addition to the president, the vice-president and the trustees of the Brooklyn Bridge, among the others were Ex-Mayor Chas. A. Schieren, H. M. Littell, president of Atlantic Avenue Electric Railway; Dennis Sullivan, president Coney Island and Brooklyn Steam Railroad; F. B. Scott and F. H. H. Sheppard, of the Baltimore and Ohio R. R; Major G. W. McNulty, A. C. Vosburg, Raw Hide Pinion Co., Syracuse. The General Electric Co. was represented by W. J. Clark, A. K. Baylor, C. B. Martin (in charge of the installation), R. H. Beach and F. Gilbert.



BROOKLYN BRIDGE MOTOR CARS—END VIEW OF TRUCK.

ELECTRICALLY OPERATED TURRETS ON THE BROOKLYN.

The new United States war ship Brooklyn will have half the number of her turrets operated by electric power and the other half by steam-power, in order to test the two methods by comparison. It is stated that the movements of a turret can be perfectly coutrolled by the electric power.

In a dispatch on the subject, from Washington, it is stated that the French turrets on the Canet electric system are said to work very well, and they have besides safety gear a system of counter weights to provide for the automatic return of lever handles. In order, also, to provide against accidents, they are supplied with a supplementary hand gear. It is said that about forty Canet turrets worked by electricity have been turned out for different ships, or are now in progress. The work has been perfected so that comparatively small powers are required for turning the turrets. England's Powerful and Terrible have electrically worked barbette mounts for their 9.2-inch guns.

One stimulus to the introduction of electrical instead of hydraulic machinery for turret turning has been the liability of the latter to suffer in winter from the freezing of the water.

Mr. F. H. Angell has again become associated with the C. & C. Electric Co., 143 Liberty street, New York.

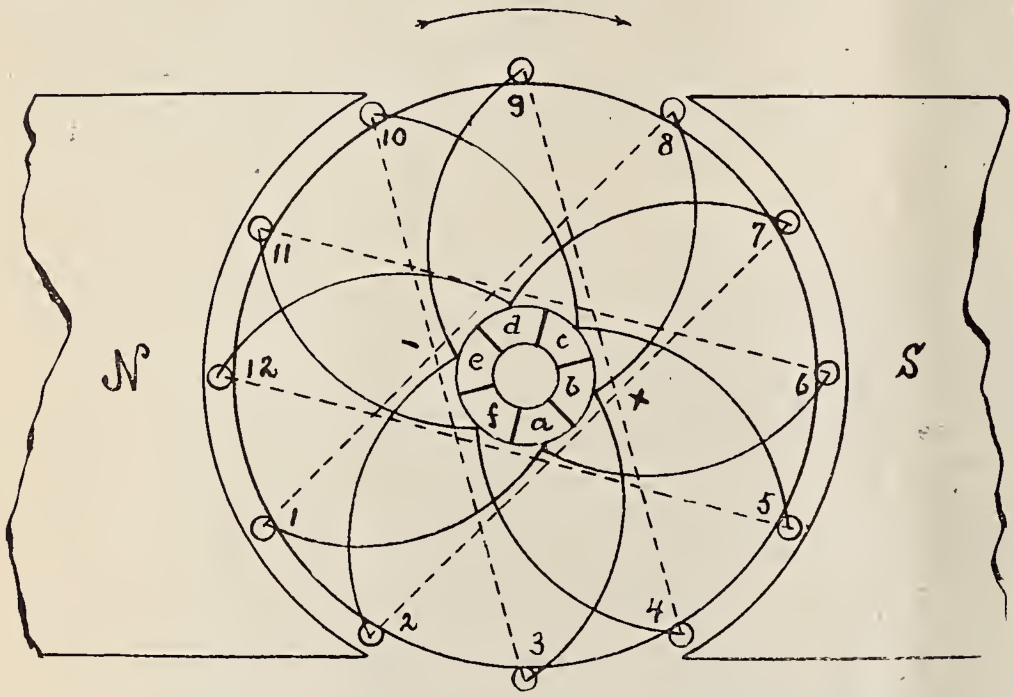
PRINCIPLES OF DYNAMO DESIGN.

BY

Newton Harrison E.E.

(*Continued from page* 41.)

The two sketches with their appended tables show the characteristic types of winding for a bipolar drum armature.



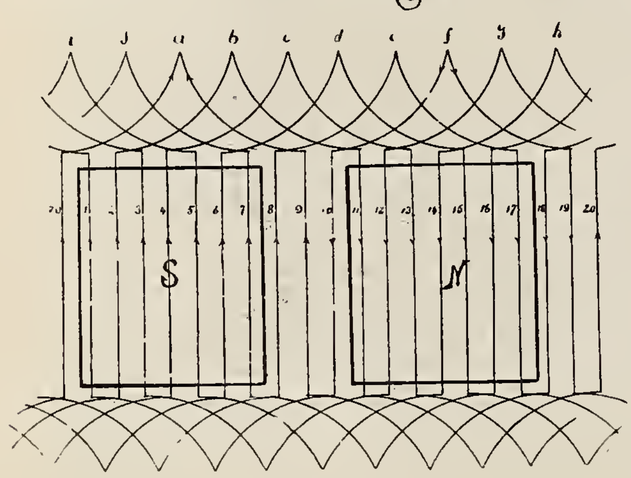


TABLE.
Spacing = 7
I = 12

	F	B	F
		1	8
+ b		3	10
		5	12
		7	2
— e		9	4
		11	6

LAP WINDING.

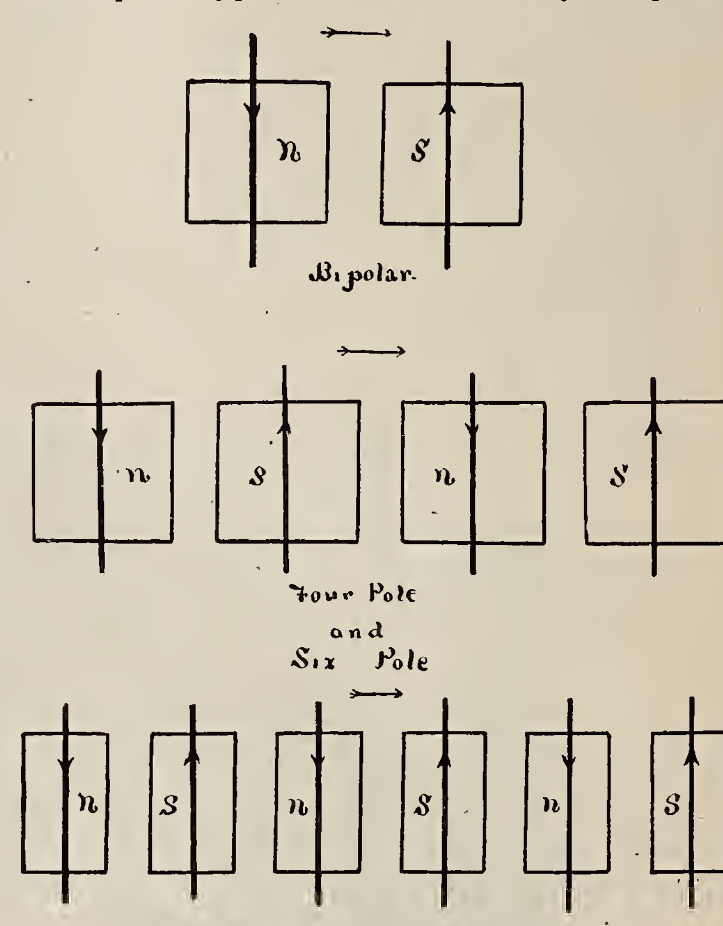
WINDING, DEVELOPMENT AND TABLE OF A 12-INDUCTOR DRUM ARMATURE.

With the sketch as shown, the position of the positive brush on the commutator is due to the direction of winding; that is to say, it is left-handed. By reversing the direction of the end connectors the + brush would be at the other side.

The above sketch diagrammatically displays the typical wave winding of a bipolar drum. A turn moves in a manner characteristic of that special winding, and returns to the adjacent commutator segment from which it started.

Multipolar Armatures.—The most convenient way of considering a multipolar generator is to look upon it as a means of combining the frames of two or more machines around the armature of one. In other words, it is a condensed type of machine of more than two poles acting in unison upon a single armature, which, by its special winding and commutating device, enables it to effectively discharge its functions as a compound machine.

Thus a multipolar type would be one really composed

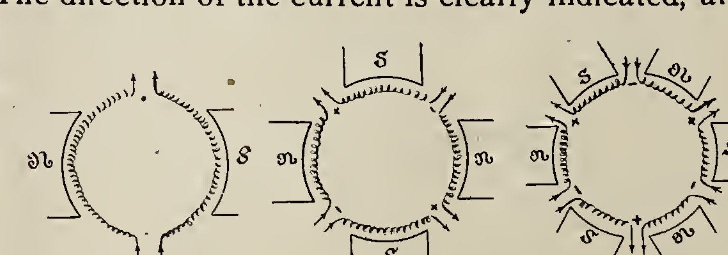


DEVELOPMENT ON FLAT SURFACE.

of either one, two or more pairs of poles, etc., whose field centralizes itself upon a unique armature, producing in it electromotive forces whose direction must be carefully guided for each purpose desired. As two or more dynamos can be thrown into multiple or series, so can the electromotive forces of a multipolar armature be similarly tested and a multiple or series flow produced. With a two-pole machine there are ordinarily two multiple circuits; with a four-pole, however, there are four and with a six-pole, six multiple circuits, which can be left in parallel, each supplying an equal E. M. F., or can be thrown into series, that is to say, multiple series, comprising in all cases only two complete circuits in multiple.

This can be, perhaps, better appreciated by examining the direction of flow when the winding and poles are developed on a flat surface.

The direction of the current is clearly indicated, and the



DIRECTION OF CURRENTS ON ARMATURES.

possibility of connecting up either in multiple or series as required.

With a Gramme armature the coils are grouped in four, six or eight sets of equal E. M. F. and may be thrown into series by cross-connecting, leaving but two branch circuits.

The general direction of the currents may be illustrated on a ring and drum armature by the ordinary spiral winding commonly used, and the lap and wave winding employed for multiple and series winding on a drum.

(*To be Continued.*)

DIELECTRIC STRENGTH OF OILS UNDER ALTERNATING POTENTIALS.

BY ELIHU THOMSON.

In the course of tests made under the direction of the writer some two or three years ago, the interesting fact was noticed that the striking distances of high potentials in insulating oils were in some way variable with the frequency of the current or potential waves, or upon the time during which electric stresses existed in a given direction through the medium.

This relation has been confirmed by other and later experiments. The general effect was found to be that discharges at low frequencies are capable of puncturing mineral oil layers up to from one-third to one-half the thickness of an air layer required to just resist puncture by the same discharges, while with high frequencies of equal striking distance in air, an oil layer of one-thirtieth to one-sixtieth of the thickness of the air layer was sufficient to prevent discharges. At frequencies such as 125 per second a potential which would give one-half inch spark in air may puncture from one-third to one-fourth inch of oil between the electrodes, while at frequencies of 50,000 to 100,000 a layer of oil of one-fourth inch may resist puncture when the spark in air is as much as eight inches. The high frequencies experimented with were such as are given by condenser discharges over an air gap including a primary of a few turns, with a secondary of a single layer of some hundreds of turns immersed in oil. The discharges, in such case, are not continuous waves, but a rapid succession of oscillatory discharges with dead intervals or periods of inactivity intervening.

The effect of carefully drying an oil was found to increase its insulating power. This was also true to a marked extent when careful filtering was resorted to, a decided decrease of striking distance through the oil with the lower frequencies being observed. It follows from this that all oil used in insulating for high potentials with low frequencies should be kept clean and homogeneous, and free from floating particles.

Variations of temperature of oil did not, in the experiments made, greatly affect the striking distances for a given potential. The general fact, however, that with high frequencies the insulating power of oil layers is, as measured by the striking distance in air relatively to that in the oil, far in excess of such insulating power for low frequencies, seems to be unaffected by the dryness, clearness or temperature of the oil used.

It appears probable, also, that with partially conducting liquids like alcohol and water the behavior with high frequencies is more like that of a true dielectric insulator than with low frequencies. As an interesting fact in this connection it may be noted that a high potential high frequency coil, capable of yielding spark torrents over thirty inches of air gap between its terminals, still maintains its discharges even when shunted by a glass tube one and a half inches in diameter containing ordinary water, and long enough to bridge the gap.

It is difficult to account for the differences in the effects obtained with high frequencies from those with low frequency alternating waves. A time lag in the establishment of the full dielectric stress or full electrostatic field in the oil might account for the phenomena According to this hypothesis if two electrodes under oil, separated a certain distance, instantly acquire a difference of potential, this potential would not with equal rapidity strain the oil to the full extent. It might be assumed that the polarization of the oil molecules requires time. Or, it may be that only such part of the electrostatic field as is due to the ether is first established after electrification and that the increase of such field due to the molecules of the substance, such as the interposed oil, is subsequent to the former.

If this were so the establishment of an electrostatic field at high rates in oils would present analogies with the case of magnetic fields in iron or metals.

It would also follow, if the supposition of a lag as above be true, that in condensers such as those using oil as a dielectric, the capacity would be less the higher the frequency. Again, if any such lag as is assumed exists, it would probably vary with different insulating media and it may depend upon the molecular state, as viscosity, for example. Observations of the oil space between the immersed electrodes by polarized light could probably be used with certain media to detect any differences in time of establishment of electrostatic stress with different frequencies, it being well known that under high stresses certain insulating liquids become strongly affected in their optical properties, with rotation of polarized beams of light traversing them. If the optical effect noticed should be less in the case of high frequencies than with low rates, it would indicate a probable lag of the kind assumed. Similar studies, using solid dielectrics like glass, mica, etc., would also be desirable. Should the results be negative it would be necessary to attack the problem in some other way.

M. P. Jaret, about a year or more ago, in a communication to the Paris Academy of Sciences, gave the results of his investigation of the properties of mica He found that it did possess, with rapid oscillations, what might be termed a dielectric hystersis. Such a property may exist to a more marked degree in oils.

In the tests of the power of oil layers to withstand puncturing by high potentials a curious effect was noticed, which was that discharges under oil passed far more readily between balls than between sharp points. In other words, with any given difference of potential between the immersed electrodes, as measured by the air spark obtainable, pointed electrodes could be brought much nearer than balls without provoking puncture. With balls of one-half inch diameter as terminals and with low frequency (125) potential differences, ranging from 100,000 to 150,000 volts, the space between the points could be one-quarter that between the balls. The ratio between the length of spark in air and between sharp points in oil was 10 to 1 at 10,000 volts and 8 to 1 at 15,000, while with balls these ratios fell to 2.4 to 1 and 2 to 1, respectively. When flat plates were substituted for the balls the striking distance in oil was still further increased as compared with the distance with points. The seemingly anomalous action of points under oil, so different from their action in gases or air, is certainly curious, and the usual injunction to avoid points and edges as conducive to electric discharge does not seem to apply in such media as oil, at least when the potentials are alternating and at ordinary frequencies.

In experimenting with discharges in oil uniform results are only to be obtained by using carefully filtered oil, as ordinarily they contain suspended particles, fibres, etc., which appear to bridge the space between the electrodes and provoke a break-down due to the non-homogenous character of the dielectric. It is also necessary to discard oil after arcing has once occurred through it, as it will have become much weaker, owing doubtless to the fine carbon particles set free and which remain floating ready to be drawn into the space between the electrodes, thus giving rise to loss of homogeneity of the medium.

LIGHTNING PROTECTION OF SHIPS.

Ships at sea are readily subject to lightning discharges unless thoroughly protected. The best system of protecting vessels is that invented by Harris. Lightning rods are connected with a series of copper plates and rods so placed on the masts as to readily yield to strains. These plates, or rods, are electrically connected with the copper sheathing of the vessel, and with all large masses of metal in the vessel. In the case of iron vessels they are connected with the hull itself.

There was at first considerable opposition to Harris's method of protection, but its efficacy was finally proved and now serious effects of lightning on vessels are almost unknown. Harris, in 1845, was knighted by the English government for his services in this respect.

DEPARTMENT OF ELEMENTARY EDUCATION.

BY THE EDITOR.

[*Note.—Any one is invited to ask questions on any point that is not made clear in these articles. Suitable explanations will be cheerfully given under the head of* "*Answers to Inquiries.*"]

(*Continued from Page* 68.)

Considerable time can often be saved by running a number of wires from one part of the building to another part, at the same time, whenever they happen to come together, but difficulty is usually experienced in keeping track of the individual wires. This trouble can, to a very large extent, be avoided by getting wire with insulation of as many different colors as possible, and dividing the building off in sections, using a different colored wire for each room in a section; or, each section may be wired in one color, and the annunciator connections in the following manner: Assuming that section No. 1 takes in rooms from No. 1 to No. 25. Connect these 25 wires at the bottom, or highest numbers on the annunciator. The buttons in the rooms should then be pressed, beginning with No. 1 and continuing up to No. 25, in regular order, an assistant making a note of the numbers in rotation as they fall. After all buttons have been pressed, the wires can then be changed to their proper places on the annunciator, using the memoranda of the test to guide us in the proper location of the wires, so that the numbers on the annunciator drops will correspond with those of the rooms.

In the diagram (Fig. 15) A represents the annunciator; B, the battery; P, the push-buttons. The wires, B W, are the battery wires above referred to. Five cells of battery are generally sufficient for an installation of not more than 100 rooms. For a greater number of connections more battery should be provided. The cells should be connected in series—that is, one after the other.

A combination of an annunciator and fire-alarm and return call system is shown in Fig. 16. This is a very valuable apparatus for a hotel, inasmuch as it sounds an

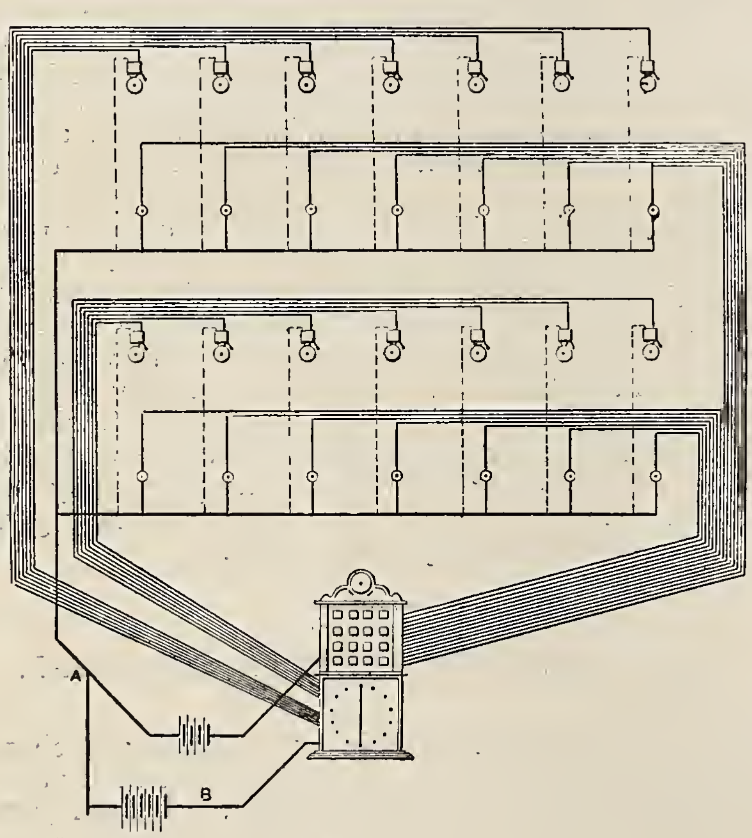


FIG. 16.

alarm all through the building in case of fire. The annunciator part of the system is precisely the same as that just described. The fire alarm feature is added to it, without altering the connections in any manner. After selecting the position for the alarm bell in each room, and the bell is placed, one wire is run from the bell and spliced to the battery wire of the annunciator system, as shown by the dotted lines, and the other wire from the bell is run direct to the annunciator as shown. For the fire alarm a separate battery is used. By tapping the annunciator battery wire at A and running this extra wire to the battery and thence to the annunciator dial, the work is finished. When a guest rings from his room the clerk can acknowledge the call by simply touching the button on the dial corresponding to the number of the room which will ring the room bell as an answer.

In case of fire the lever on the dial is released and, in revolving, causes every bell in the house to ring for a considerable length of time.

This apparatus is very simple and effective, and com-

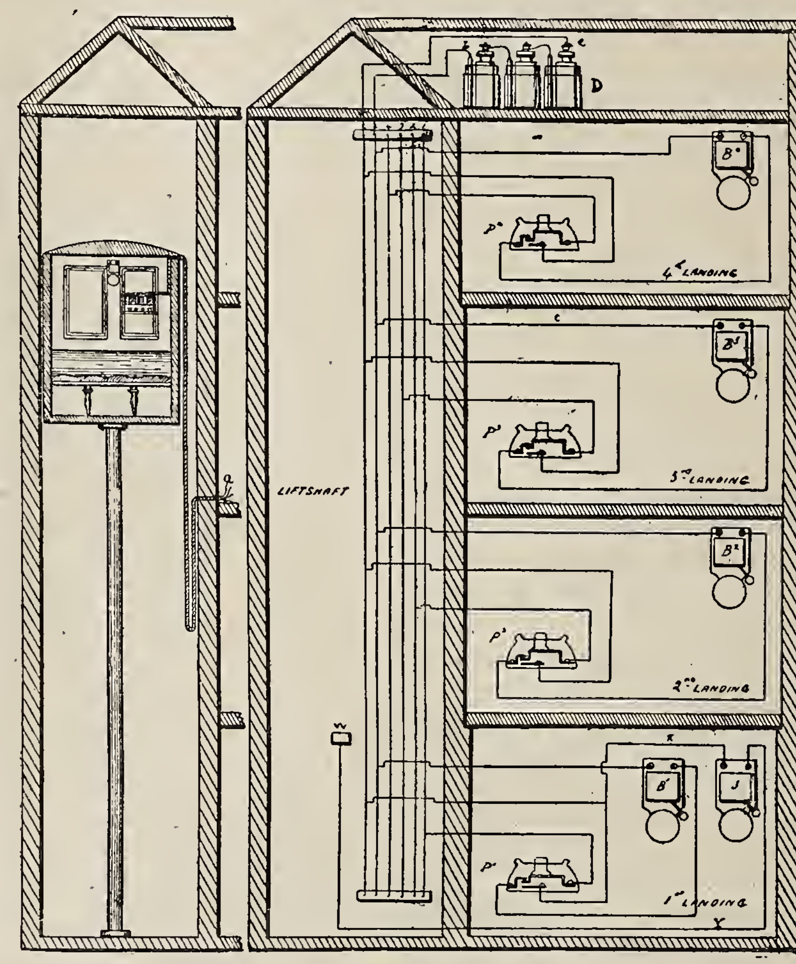


FIG. 17.

mends itself for its freedom from complicated mechanism and connections.

In closing this subject it remains for us to refer to the method of installing annunciators on elevators, or "lifts," as the Englishman calls them. The connections are the same as for stationary work, the difference in the systems being that for elevators the wires are constantly moving up and down. A cable containing the required number of wires is provided, one end being securely fastened midway between the top and bottom of the shaft, and the wires from the different floors run to that point and connect with the conductors in the cable. The other end of the cable is fastened in a similar manner to the bottom of the elevator and thence to the annunciator in the car. The battery is usually placed on the lower floor or in the basement, or it may be placed on the top floor or any other more convenient location, outside of the elevator itself.

A diagram of an elevator circuit is shown in Fig. 17.

(*To be Continued.*)

HOW OUR ELEMENTARY DEPARTMENT IS APPRECIATED.

February 6th, 1896.

Dear Editor:—In looking over this week's edition I found that you had an annunciator burglar alarm system. It interested me very much, and now I am making a temporary one for myself, and if I prove successful I will write to you and let you know. I will close now, saying that the Electrical Age is the most interesting book I ever read or bought.

Yours truly,
Wm. Smith,
120a Court street, Brooklyn.

ANSWERS TO INQUIRIES.

[*Note.—This column is open to any of our readers who desire special information on any subject. In case we cannot give the desired information ourselves the inquiry will be published, in order to elicit a reply from some one of our readers. These answers will be published in due course.*

The full names of our correspondents will not be published, but for the purpose of identification their initials or other mark of identity will be substituted therefor.

Each question will be numbered for the purpose of ready reference.

All are invited to make free and liberal use of this column.]

23.—Kindly inform me how to go about it to get information in regard to the electrical probabilities and possibilities of a certain Southern city, with a view to bettering my condition as an electrician. W. A H., Harlem.

A.—If our correspondent means that he wishes to secure a position in the city referred to we think the best course for him to pursue would be to communicate with the president or general manager of the electric light or street-railway company in the place, if there are such enterprises there. If not, the mayor of the city might be able to give some information as to the "probabilities and possibilities."

24.—In case a man wished to light up his residence, or but a single room with electricity, in a neighborhood where there is no electric plant, what would be the requisites and approximate price of each? Answer in AGE. J. H. W., Lewisberry, Pa.

A.—For small lighting a primary battery plant would give good satisfaction. We give the price per unit of each article that would be required to install such a plant. To find the total cost simply multiply the number of articles of each kind by the unit price.

One 8-volt incandescent lamp	$1.00.
4 cells bichromate battery to light lamps	2.00.
1 socket	.50.
Cord	.50.
Shade	.25.
Total for one lamp outfit	$4.25.

Wire costs from 38 cents to 50 cents per pound in New York, according to size. We refer our correspondent to the article printed in THE ELECTRICAL AGE of February 1; headed "Primary Batteries for Domestic Lighting." This article gives a great deal of valuable information on this subject.

25.—Would it be practicable to place a small gasoline engine and dynamo in a two-horse wagon to be driven about from place to place, to be stationed beside a church or hall, and supply current for two arc lights for stereopticon exhibitions? About what would be the weight and cost of such engine and dynamo? M. A. M., Wevertown, N. Y.

A.—Yes, it would be quite practicable. One 1 h.-p. dynamo will give you two arc-lights. Such a dynamo will cost about $100, and weigh about 125 pounds. A gasoline engine would cost about $200 and weigh 250 pounds. Total cost, $300; total weight, 375 pounds. A gasoline tank should be provided, and the dynamo and engine should be direct-connected, if possible, to economize space. The wagon should have good, easy springs, to prevent sudden jars.

26.—What are bus bars? W. A., Johnstown, Pa.

A.—Bus bars are heavy copper bars employed in a central or distributing station, to which all of the terminals of the generating dynamos are connected, and from which the current passes to the different points of the distribution system over the feeders.

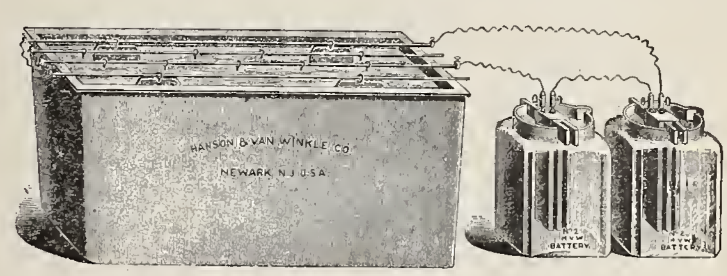
PERSONAL.—Mr. J. M. Duncan has just taken the management of the New York office of the Campbell & Zell Company, manufacturers of the Campbell & Zell water-tube safety boiler. Mr. Duncan's office is in the Havemeyer building.

ELECTRO-PLATING.

Electro-plating is the process of covering a surface with a metal by the aid of a current of electricity—the surface to be plated must, however, possess some electric conductivity.

By the aid of electro-plating it is possible to coat the baser metals, such as iron, etc., with a film or layer of silver, gold or platinum, or with any other metal, such as copper, nickel, etc. The carbons of arc lights furnish an example of copper-plating on a non-metallic surface.

The process of electro-plating is conducted in the following manner: The object to be plated is connected with the negative terminal of a battery and placed in a solution of the metal with which it is to be plated, opposite a plate of the same metal connected to the positive terminal of

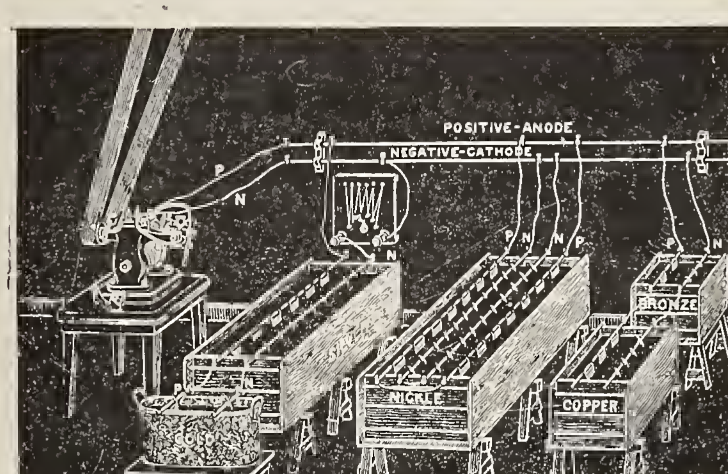


ELECTRO-PLATING BY BATTERY.

the battery. If, for example, the object is to be plated with copper it is placed in a solution of copper sulphate (blue vitriol) opposite a plate of metal copper. By this arrangement the object to be plated forms the *kathode* of the plating bath, and the plate of copper constitutes the *anode*.

The electric current generated by the battery decomposes the solution of copper sulphate, metallic copper being deposited on the articles attached to the kathode. The copper plate maintains the strength of the solution of the bath by giving up to the solution as much of its substance as is taken from the solution and deposited upon the articles. Therefore the copper plate is gradually consumed.

When any other metals, such as gold, silver, nickel, platinum, etc., are to be deposited, suitable solutions of



ELECTRO-PLATING BY MACHINE CURRENT.

their salts are placed in the bath and plates of the same metal suspended at the anode, as was the copper plate.

Electro-plating on a large scale is now accomplished by means of a direct-current dynamo machine, which is specially wound for the purpose. These machines generate the current instead of the troublesome batteries, and do not require the attention that batteries do.

DIGEST OF PHYSICAL TESTS.

We have received a copy of the first number of *The Digest of Physical Tests and Laboratory Practice*, which will be published quarterly by Frederick A. Richlé, of Philadelphia. The purpose of this new magazine is to give a résumé of practical tests made in the laboratories of the world.

LIABILITY OF STOCKHOLDERS.

Justice Beach, sitting in Supreme Court Chambers, on January 30, decided that the courts of this state will not recognize the modes of procedure prescribed in the statutes of another state for the enforced collection of personal liabilities to a bankrupt corporation.

The case upon which this decision was based was a suit brought by the Sprague Electric Railway and Motor Company, the Edison General Electric Company and Harry B. Thompson, receiver of the Steubenville (Ohio) Street Railway Company, against the Steubenville Street Railway Company, Gilbert M. Speir, Jr., and others.

The Steubenville Street Railway Company was organized by the late Maurice B. Flynn. The articles of incorporation were filed in May, 1889, and the charter was obtained under the laws of the State of Ohio.

The capital stock of the company is $70,000, divided into seven hundred shares of $100 each. The total amount was subscribed for by the defendants. There was besides an issue of $75,000 in bonds, most of which were disposed of to outside parties. These bonds were registered by the Atlantic Trust Company of this city.

Shortly after procuring the proper franchises the equipment was changed from horses to electricity. The cars and other appliances were furnished by the Sprague Electric Railway Company and the General Electric Company.

The Court of Common Pleas of Jefferson county, Ohio, declared the street railway company to be insolvent, and on June 25, 1894, appointed Harry B. Thompson receiver. The financial condition of the company was deplorable. There were general liabilities approximating $50,000, with no assets save the property and franchises of the street railway, which, upon appraisement, were valued at $12,375. As this was pledged to meet the bond issue of $70,000 there was actually nothing with which to pay the other creditors.

The receiver discovered upon going over the books that the stockholders had paid but ten per cent. of their subscriptions. Under the laws of Ohio shareholders are liable for twice the face value of their holdings. Suit was then instituted to recover not only twice the face value of the stock, but also for the original ninety per cent. on the unpaid subscriptions.

As none of the holders of stock resided in Ohio or were within the jurisdiction of the courts of that state, the suit was transferred to the Supreme Court in this city. D. M. Porter, as attorney for several of the defendants, made the point that the law respecting the liabilities of stockholders mentioned in the suit was not according to the statutes of this State, and that therefore the courts of this state should not recognize it. Justice Beach rendered his decision in favor of the defendants.

RESIGNATION OF MR. LITTLE.

We have been officially informed of the resignation of Mr. E. W. Little as vice-president and general manager of the Interior Conduit and Insulation Co., of New York.

Mr. Little was associated with the company from the time of its incorporation, and what he proposes to do in the future has not yet been divulged. It is understood, however, that the electrical industry will not lose him. Mr. Little has a great many friends in the trade, all of whom wish him success in whatever he may undertake.

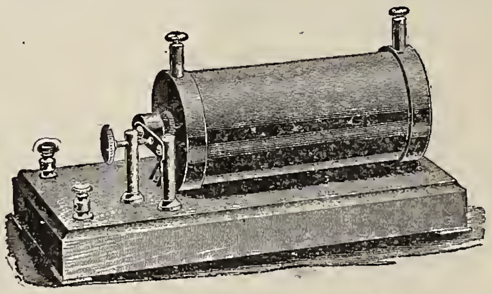
THE WAGES OF SIN IS DEATH.

A man by the name of J. V. Gove was cutting electric light wires on poles in Newark, N. J., on the night of February 3, when he received a shock which threw him to the ground. The fall fractured his skull and he died from the injury. It is supposed that Gove was stealing wire when he met his death. One of the light circuits had been cut.

INDUCTION COILS FOR CATHODE RAY PICTURES.

The experimental and practical application of the discovery of Prof. Roentgen in making pictures of objects screened by opaque substances has given an immense impetus to the induction coil business, and makers of these instruments are kept busy in their effort to supply the demand.

There is no limit to the practical application of this valuable process of picture-making, and as the induction coil is an indispensable piece of apparatus in producing the interesting results, it is likely that induction coils will at once find a rapidly and permanently expanding market.



INDUCTION COIL FOR CATHODE RAYS.

To get the best results, of course, the best apparatus should be used. Among the best induction coils made are those of the International Electric Co., 76 Beekman Street, New York. These instruments are made with great care and precision, and of the best materials obtainable.

The International Electric Co. has made induction coils for the foremost institutions of learning in this country, and these instruments are highly spoken of.

SHEEHY AUTOMATIC RAILROAD SIGNAL.

Mr. Robert J. Sheehy, the well-known electrical engineer and inventor, has on exhibition in Room 74 of the Drexel Building, in this city, a model of an automatic railroad signal system of his own invention, which is remarkable for its simplicity and effectiveness.

In this system the rails of the tracks are used as electrical conductors, and all signal appliances are placed in the cabs of the locomotives. These signals are actuated by electricity from currents carried on the locomotives and instantly notify the engineer (by striking gongs and displaying colored lights and semaphores) if there is any obstruction on the section ahead (the road being divided into proper blocks), and designate whether the obstruction is that of a train or car on the section, or if a misplaced switch, broken rail, or open drawbridge.

To accomplish these results two signals are provided, one giving notice of an incomplete track and the other showing if there is a train on the section. In the cab, in connection with these signals, is an automatic time-recording device, which records the hour, minute and second at which the signal was given, and also designates whether it was the train or track signal, again making a record when the section is cleared.

An examination of this record at the end of the run will show the length of time the train was delayed by obstructions.

The system possesses many novel and valuable features, and in design is practically a reversal of the methods of operation adopted in the usual railroad signals. All the current used in its operation is carried on the locomotive—there are no batteries along the railway line to freeze, run down or otherwise get out of order. Everything is under the eye of the engineer.

By this system the flagging of trains, approaching from the rear, is dispensed with; the fact of the train being on the track blocking that section to the rear train through the train signal in the cab of its locomotive. This positively prevents the rear end collisions.

This system is simple, costs less for equipment and maintenance than any other, and is endorsed by over three thousand practical railroad men in New England.

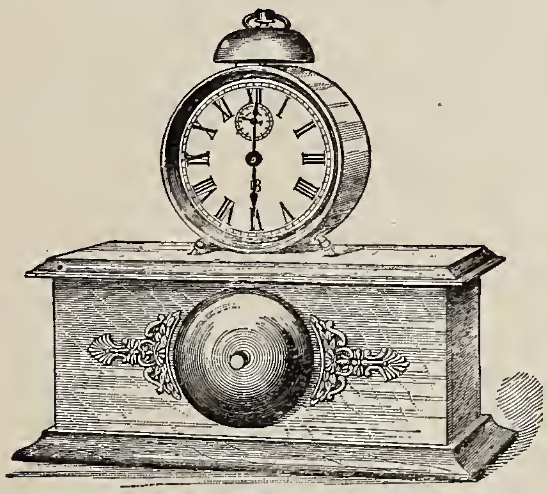
The office of the Sheehy Automatic Railroad Signal Company is at 122 Pearl street, Boston, Mass.

WAKE UP THERE.

An ingenious method of making an electric alarm clock out of any ordinary mechanical alarm clock is shown in the accompanying illustrations.

The two rear views of the apparatus show the manner in which the electrical attachment is operated.

The ordinary clock is set on top of the box, which contains a cell of dry battery. It is wound and set in the usual way, the alarm-winder being left in a perpendicular position, however. After placing the clock on the box a ring is hooked over the upper part of the alarm-winder in such a manner that it will slip off when the winder turns around (see Fig. 1).



JONES ELECTRIC ALARM CLOCK.

Fig. 2 shows the hook having slipped off, and as the tension is thus released the alarm rings, and will continue to ring until the chain is again hooked on the winder as before.

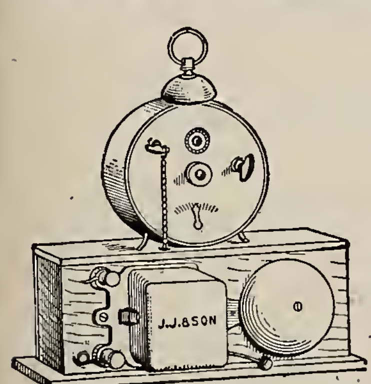


FIG. 1.

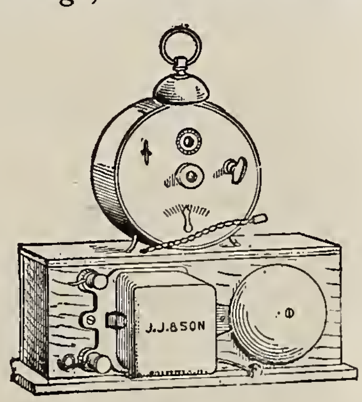


FIG. 2.

This apparatus does not permit of any one turning over to take another snooze after it begins operation, because it compels the person to get up to stop the alarm.

This outfit is manufactured by J. Jones & Son, 67 Cortlandt street, New York.

ROENTGEN PICTURES.

Editor Electrical Age.—European and American scientists are at the present time predominantly occupied with research in the matter of producing so-called negatives of objects, when opaque or non-transparent matter is directly intermediate between the object and the negative. The medium producing impressions on the negative in this case is called by the name of "x-rays,"—rays that nobody knows anything about—and the pictures are spoken of as photographs. Apparently there is as yet much confusion in the brain of the learned and skilled ones in this matter. They have, so it seems, forgotten that light is that which affects the human eye by leaving on its nerve a picture of what is focussed on it.

The sun spreads such light, but it spreads something different besides light, namely, chemical rays. They, and not the light, have made the pictures that have been improperly called light pictures or photographs.

That the electric current effects chemical reaction is well known and old, the reaction being known as *electrolysis*. Nor is electrolysis stopped by any opaque object in its way. What then is the new- angled picture-making but electrolysis?

Photographs (light-prints) should be called "heliographs" (sun-prints), and the new pictures are properly named—"electrographs." C.

A. B. SEE MFG. CO.'S NEW BUILDING.

We are informed that the A. B. See Manufacturing Company, of Brooklyn, has bought a plot of ground fronting on Pearl street, and extending through the block from Front street to Water street, Brooklyn. The company will at once begin the erection of a large building of at least six stories in height, for the manufacture of their electric elevators. The building will have a frontage of 200 feet and a depth of 100 feet. Architect M. J. Morrill, of the National City Bank Building, Brooklyn, is preparing the plans of the new building.

FINANCIAL.

The report of the Brooklyn Heights Railroad Company for the quarter ending December 31, 1895, shows gross earnings of $1,048,858, a decrease of $87,324 as compared with the same period of the previous year; operating expenses, $676,000, a decrease of $68,560; net earnings, $372,-857; decrease, $18,764. For the six months ending December 31 the gross earnings were $2,232,472, a decrease of $175,497 as compared with the last half of 1894; operating expenses $1,348,254; decrease $156,953; net earnings, 884,218; decrease $18,544. Other income and charges make the deficit for the six months $44,151.

IN AND ABOUT NEW YORK.

The Delany Heater and Rheostat Co., 463 Greenwich street, New York, has gone into the hands of a receiver. The company's assets are $3,000 and liabilities $2,650.

Robert Edwards & Co.'s Electrical Works in 144th street, New York, were almost entirely burned one night last week. All of the floors were burned through, and the machinery and stock, which were valued at $25,000, were destroyed. The fire was probably caused by spontaneous combustion in the varnish room, where several hundred gallons of oil and varnish were stored.

The Vance Electric Co., 136 Liberty street, New York, has just completed the installation in the St. Nicholas Rink, New York, of 1,100 16-c. p. incandescent lamps; 10 incandescent arc lamps, and one, two and four H. P. Lundell motors. They are also wiring the residence of Mr. Schieffelin, on 76th street, for electric light, burglar alarm and electric bells.

The Gluth & Muenster Motor and Novelty Co. has just opened an establishment at 61 Cortlandt street, New York. They manufacture all kinds of electrical supplies; perform experimental work of all kinds, and install electric bells, burglar alarms, door openers, etc., etc. Neat repairing is a specialty of the company.

Dr. J. B. DeLery, 56 Pine street, New York, is interesting capital for the introduction of the Barriere system of incandescent gas lighting. The Barriere light is similar to the Welsbach and is pure white. It is much simpler in its mechanical parts than the Welsbach.

The Emerson alternating current motor, of which Mr. N. M. Garland, 114 Liberty street, New York, is the sole agent for the Eastern States, is rapidly increasing in popularity. Mr. Garland is selling large numbers of these machines for driving fans and for power work.

THE ELECTRICAL EXPOSITION.

One of the most attractive and instructive exhibits at the forthcoming Electrical Exposition will be that of the Edison Electric Illuminating Company of New York. This display will occupy a space of over one thousand square feet, and will comprise a complete demonstration of the applications of electricity for domestic purposes. The most improved methods of house lighting will be shown in detail, also electric heating and cooking by electricity. This will be the first time that such a practical exhibition has been made of the many uses to which electricity can be applied in the home, and the understanding of the visitor will be further enlightened by a well arranged display of the various kinds of apparatus employed, all of which will be explained by those in charge of the exhibit.

Telephone Notes.

Dysart, Ia.—There is talk of the Commercial Telephone Company extending their line to this place.

Elizabeth, N. J.—The New Jersey Trunk Line Telephone & Telegraph Co. has been incorporated by Wm. A. Topping, George H. Bruce, of New York city; Benjamin A. Lawrence, of Elizabeth, N. J., and others; to build and operate lines in Essex, Passaic, Hudson and Union Counties. Capital stock, $50,000.

Livingston Manor, N. Y. — The Beaverkill Telephone Co. has voted to extend its line to Livingston Manor, where it will connect with the Sullivan County System. It was also voted to look over the route with a view to extending the line of Margaretville to a connection with the West Shore system.

Southampton, L. I., N. Y.—A telephone line via North Sea to Rose's Grove and Noyac is being arranged for and will probably be constructed before summer.

La Grange, Ind.—A paper is being circulated for the purpose of raising money to put a telephone line from Lima to Longo, by the way of Ontario and to La Grange.

Utica, N. Y.—A new telephone company is being organized, to be known as the Utica Telephone & Telegraph Co., with a capital of $25,000.

Dyersburg, Tenn.—The lines of the A. M. Stevens Lumber Co. will be extended to Heloise.

Davis, W. Va.—It is intended by the St. George & Parsons Telegraph Co. to extend its lines to Harman, Davis and other points.

Parsons, Kan.—An ordinance has been passed by the Council that an electric fire alarm be provided for at the expense of the telephone company.

Columbia City, Ind.—An incorporated company was organized in Columbia City to put in a first-class telephone. A. Adams is president.

Tecumseh, Neb.—The business men of Tecumseh are agitating the formation of a new telephone company.

Hicksville, O.—Judge Snook, W. H. Phipps and J. P. Gasser are said to be organizing a company to build a telephone line connecting Van Wert, Paulding, Payne, Antwerp, Hicksville and other towns.

Gastonia, N. C.—A company will be organized by J. D. Moore and others to construct telephone systems, etc.

TELEPHONE PATENTS ISSUED FEBRUARY 4, 1896.

Telephone. Samuel A. Dinsmore, Chicago, Ill. (No. 553,843)

Registering Apparatus for Telephones. Frank Quatram, Pankow, Germany. (No. 553,964.)

Adjusting Attachment for Telephone Signal-Bells. Cleaveland F. Dunderdale, Chicago, Ill. (No. 553,977.)

Telephone Apparatus. Carl J. Schwarze, Adrian, Mich. (No. 554,036)

Telephone System. Wallace A. Houts, Parker, S. D. (No. 554,125.)

Telephony. Charles A. Randall, London, England. (No. 554,141)

New Corporations.

Washington, D. C.—The Mount Pleasant and Zoo Gravity Railway is to have a capital of $1,000,000. A bill has been introduced in Congress allowing it to build a road in the suburbs. Among those interested are E. Bair, W. B. Hilk and L. D. Wine.

Houston, Tex.—The Fredericksburg Electric Light Co. has been incorporated by Charles H. Winistz, Jr., Ad Gold, Franz Stein and Alfred Vanderstucken. Capital stock, $7,000.

Plattsburg, N. Y.—Plattsburg and Au Sable Telegraph Co. to maintain a line of telegraph from Plattsburg to Keeseville and intermediate stations. Capital, $1,500; Directors: George E. Lynch, M. J. O'Brien, James R. Lynch, George L. Fitzpatrick and Dennis Callahan, all of Plattsburg.

Manistee, Mich.—The Manistee Electrical Supply Co. has been incorporated by J. O. Nessen and J. S. Mundy. Some specialties will be long-distance magnetic-telephones, electro-magnetic chairs, etc. Fifty men will be employed. Capital stock, $50,000.

Milwaukee, Wis.—The Milwaukee, Racine and Kenosha Street Railway Co. has been incorporated by Thomas M. Kearney, Charles M. Dietrich and Richard T. Robinson; to build and operate a street railway system, to be propelled by electricity or other power, from South Milwaukee, northerly through the village of Cudahy and the towns of Lake and Oak Creek, and the city of Kenosha. Capital stock, $100,000.

New Rochelle, N. Y.—Birdsall Electric Manufacturing Co.; capital, $10,000; Directors, Theodore Birdsall, of New Rochelle; S. K. Johnson, Criminal Court Building, and Bryce Marr, both of New York City.

Richmond, Va.—The Fairmount Traction Co. has asked a franchise from the legislature to construct an electric road in Richmond and Henrico County. William T. Hechler and William J. Westwood are among those interested.

Possible Contracts.

Albany, N. Y.—The State Railroad Commissioners approved an application of the Binghamton, Lestershire and Union Street Railway Co., for an increase of its capital stock from $100,000 to $250,000. The company is to put in new equipment.

Springfield, Ill.—Plans have been prepared by Architect J. I. Rinaker for the erection of a seven-story office I. O. O. F. building, which will have electric lights, etc.

Yonkers, N. Y.—The Yonkers Electric Railroad Co. is having plans prepared by Edward A. Quick & Son for a two story brick power-house, repair shop and car house in Buena Vista avenue near Main street, to cost $40,000.

Plattsburgh, N. Y.—The Plattsburgh Village Trustees granted a franchise to the Plattsburgh Traction Co. giving the company the right to build, maintain and operate an electric street railroad in the village. The company expects to have the road in operation between Plattsburgh and Bluff Point by July.

KENSINGTON, N. Y.—Ground has been purchased, adjacent to Kensington, on which a power-house will be erected for a proposed system of electric railways to connect with Kensington, Arnold, Parnassus and extend to Pittsburgh.

PITTSBURGH, PA.—The Second Avenue Traction Co. is perfecting arrangements to connect McKeesport with Pittsburgh, via. Brinton Station, thus completing a circle beginning and ending at 4th avenue and Market street, Pittsburgh.

TRENTON, N. J.—John A. Roebling Sons' Co. will put in their works a new electric light plant of greater capacity.

NEW YORK CITY.—A fifteen-story office building is to be erected by the Cass Realty Corporation, 503 5th avenue, at 43 and 45 West 32d street, at a cost of $150,000.

—A six-story brick store is to be erected by Harry Chaffee, 365 West 23d street, at 43-49 Bleecker street, at a cost of $160,000.

BROCKTON, MASS.—Several well-known residents of this city, including Hon. W. L. Douglas, Ex-Mayor Whipple and Ex-Alderman Merritt and others, have organized the Brockton, Bridgewater and Taunton Street Railway Co., to construct a railway from the Montello Railroad station through Brockton, West Bridgewater, Raynham and Taunton. The road will be 18 miles long. The capital stock is $100,000.

MIDDLEBORO, MASS.—A movement has been started for the erection of a new hotel on the site now occupied by the American Building at Middleboro. It is the intention of the promoters to erect a five-story brick block with a frontage of 80 feet on Main street, and 100 feet on Water street. It is hoped to organize a stock company with a capital of $75,000.

POTTSTOWN, PA.—The Pottstown and Westchester Electric Railway Co. will begin the construction of its electric road in the spring, and they are now making arrangements for same.

NEW YORK CITY.—Messrs. Weil & Mayer are to put up a seven-story store and loft building at 50 Bond street.

BOSTON, MASS.—Architects are at work on the plans, and by April 1 the work of tearing down the old buildings for the new hotel at Tremont and Boylston streets will be begun. Landlord Whipple, of the Parker House.

PORTLAND, ME.—It is understood that the tracks of the electric road, on Spring and Vaughan streets, are not heavy enough and will be relaid in the spring.

GLEN COVE, L. I., N. Y.—General James R. Pearsall has announced that the Hempstead Harbor Hotel and Casino Co. has been formed to build a hotel with all modern improvements. Architect Gilbert of New York is already at work on the plans.

KENOSHA, WIS.—The Bell City Street Railway Co. has applied for a franchise to construct and operate an electric road.

NEW YORK.—Architect M. J. Morrill, National City Bank Building, Brooklyn, N. Y., is preparing plans for a large factory for the A. B. See Manufacturing Co., Brooklyn. The building will be erected on Pearl street, between Front and Water.

Trade Notes.

The Partridge Carbon Co., of Sandusky, Ohio, has had phenomenal success with its carbon-motor brushes. Street railway companies appreciate these brushes to such an extent that they will have no other. In their estimation there is no other "equally as good." This they have learned by experience.

ELECTRICAL and STREET RAILWAY PATENTS

Issued February 4, 1896.

553,831. Secondary Battery. Anthelme E. W. Boucher, Prilly, Switzerland, assignor to the Societe d'Electro-Chimie, Paris, France. Filed August 13, 1895.

553,838. Successive Non-Interference Signal-Box. Frederick W. Cole, Newton, Mass., assignor, by mesne assignments, to The United States Fire and Police Telegraph Company, Portland, Me., and Boston, Mass. Filed April 21, 1890.

553,839. Non-Interference Signal-Box. Frederick W. Cole, Newton, Mass., assignor, by mesne assignments, to The United States Fire and Police Telegraph Company, Portland, Me., and Boston, Mass. Filed March 7, 1891.

553,840. Successive Non-Interference Signal-Box. Frederick W. Cole, Newton, Mass., assignor, by mesne assignments, to The United States Fire and Police Telegraph Company, Portland, Me., and Boston, Mass. Filed May 3, 1890. Renewed June 29, 1891.

553,843. Telephone. Samuel A. Dinsmore, Chicago, Ill. Filed March 8, 1895.

553,844. Insulating-Joint. William O. Duntley, St. Louis, Mo. Filed March 25, 1895.

553,847. Electric Transformer. Walter K. Freeman, Fort Wayne, Ind. Filed July 5, 1895.

553,849. Car-Fender. Thomas F. Gardner and Michael J. Carney, Pittston, Pa. Filed June 27, 1895.

553,857. Electric Light Switch. Harry W. Lawrence, Denver, Colo., assignor of one-half to William A. Blakeney, same place. Filed April 1, 1895.

553,858. Spring Supporting-Ear for Trolley Wires. Charles A Lieb, New York, N. Y, assignor to the General Electric Company, of New York. Filed June 23. 1894.

553,873. Non-Interfering Signal Apparatus. John J. Ruddick, Richmond, Ind., assignor, by mesne assignments, to The United States Fire and Police Telegraph Company, Portland, Me., and Boston, Mass. Filed June 28, 1890.

553,890. Electric Programme-Clock. Herman T. R. Zeidler, Berlin, Germany. Filed June 29, 1895.

553,900. Electrical Whistle-Controlling Device. Arthur E. Colgate, New York, N. Y., assignor to George J. Schoeffel, Brooklyn, N. Y. Filed November 24, 1894.

553,901. Automatic Current-Regulator. Stanley C. C. Currie, New York, N. Y., assignor of seven-twentieths to Edward N. Dickerson, same place. Filed February 20, 1895.

553,911. Regulating-Socket for Incandescent Lamps. Alvin B. Hendricks, St. Mary's, Ill. Filed June 19, 1895.

553,919. Electric-Arc Lighting. George R. Lean, Cleveland, Ohio, assignor to the Jandus Electric Company, same place. Filed September 26, 1895.

553,920. Electric Arc-Lighting System. George R. Lean, Cleveland, Ohio, assignor to the Jandus Electric Company, same place. Filed September 27, 1895.

553,921. Electric-Arc Lighting. George R. Lean, Cleveland, Ohio, assignor to the Jandus Electric Company, same place. Filed September 27, 1895.

553,923. Apparatus for Electric Welding. Hermann Lemp, Lynn, Mass., assignor to the Thomson Electric Welding Company, of Maine. Filed June 17, 1891.

553,927. Electric Trolley. Nelson Muslar, West Boylston, assignor to Henry F. Harris, Worcester, Mass. Filed April 9, 1894.

553,952. Electric Railway. Augost Casazza, Hoboken, N. J. Filed December 13, 1894.

553,957. Telegraphy. Patrick B. Delany, South Orange, N. J. Filed July 25, 1891.

553,960. Electrical Igniting Device. Wilhelm Kaiser, Vienna, Austria-Hungary. Filed September 6, 1895.

553,964. Registering Apparatus for Telephones. Franz Quatram, Pankow, Germany. Filed July 26, 1895.

553,965 Electrician's Screw-Driver. Joseph Reece, Pulaski, N Y. Filed May 31, 1895.

553,977. Adjusting Attachment for Telephone Signal-Bells. Cleaveland F. Dunderdale, Chicago, Ill., assignor to the Automatic Long Distance Telephone Company of Chicago, Ill., of Illinois. Filed June 27, 1895.

553,979. Electric Railway. Frederick C. Esmond, Brooklyn, N. Y., assignor to the Esmond Electric Traction Company, of West Virginia. Filed April 19, 1893.

553,980. Electric Railway. Frederick C. Esmond, Brooklyn, N. Y., and Harding F. Gray, Passaic, N. J. Filed May 4, 1893.

553,981. Circuit-Controlling Device for Electric Railway Systems. Frederick C. Esmond, Brooklyn, N. Y., assignor to the Esmond Electric Traction Company, of West Virginia. Filed July 1, 1893.

554,016. Pressure-Alarm for Gas-Supply Pipes to Furnaces. Francis S. Baker, Chicago, Ill. Filed July 22, 1895.

554,018. Combined Car Brake and Fender. Arthur K. Bonta, Hoboken, N. J., assignor to the Bonta Manufacturing Company, same place. Filed May 22, 1895.

554,036. Telephone Apparatus. Carl J. Schwarze, Adrian, Mich. Filed September 17, 1895.

554,042. Fuse-Box. Jay S. Strouse, Baltimore, Md. Filed October 5, 1895.

554,043. Electric Battery. David S. Williams and Harry M. Hamrick. Philadelphia, Pa., assignors to the North American Electric Storage Company, same place. Filed May 15, 1895.

554,063. Commutator for Magneto-Electric Machines. John C. Henry, Westfield, N. J. Original application filed December 16, 1891. Divided and this application filed March 31, 1893.

554,064. Car-Fender. William H. H. Heydrick, Philadelphia, Pa., assignor of one-half to Christopher R. Blackall, same place. Filed August 15, 1895.

554,074. Electrical Circuit-Closer. Lebbeus B. Miller, Elizabeth, N. J. Filed August 3, 1895.

554,080. Automatic Switch James F. McElroy, Albany, N. Y., assignor to the Consolidated Car Heating Company, same place. Filed January 2, 1982.

554,083. Electric Time and Signal Recorder. Charles E. Ongley, New York, N. Y., assignor to George J. Schoeffel, same place. Filed December 8, 1893.

554,089. Electric Carriage-Lamp. Patrick H. Quinn, New York, N. Y., assignor of one-half to Allan Lexow, Hoboken, N. J. Filed December 3, 1895.

554,097. Apparatus for Railway Signaling and Switching. John D. Taylor, Chillicothe, Ohio. Filed October 29, 1894.

554,102. Underground System for Electric Railways. William P. Allen, Chicago, Ill., assignor, by direct and mesne assignments, of two-thirds to Oliver S. Kelly and Alvaro S. Krotz, Springfield, Ohio. Filed June 22, 1895.

554,103. Electric Conductor and Contact Device Therefor. William P. Allen, Chicago, Ill., assignor, by direct and mesne assignments, of two-thirds to O. S Kelly and Alvaro S. Krotz, Springfield, Ohio. Filed July 15, 1895.

554,104. Underground System for Electric Railways. William P. Allen, Chicago, Ill., and Alvaro S. Krotz, Springfield, Ohio, assignors of one-third to Oliver S. Kelly, Springfield, Ohio. Filed August 23, 1895.

554,112. Telegraph-Key. William Deats, Amawalk, N.Y. Filed June 16, 1894.

554,119. Car-Fender. John F. Girtler, Brooklyn, N. Y., assignor to John F. Girtler, Gaston E. Constantin, Adolf Glaus and Friedrich Heinemann, same place. Filed July 24, 1895.

554,124. Electric Battery. Charles J. Hirlimann, Fort Lee, N. J. Filed October 25, 1895.

554,125. Telephone System. Wallace A. Houts, Parker, S D. Filed December 24, 1894.

554,130. Fuse-Holder and Lightning-Arrester. Harry A. Lewis, Norristown, assignor of nine-twentieths to James C. Yerkes, Reading, Pa. Filed January 17, 1895.

554,138. Mechanical and Electrical Development and Storage of Wind-Power. Walter L. Negbaur, Brookline, and Joseph J. Feely, Walpole, Mass. Filed October 9, 1895.

554,141. Telephony. Charles A. Randall, London, England. Filed December 31, 1894.

554,149. Car-Fender. Luke E. Sicard and John Frazee, New Orleans, La. Filed September 5, 1895.

554,158. Car-Fender. Charles Welsh, Ilchester, Md., assignor of one-half to Milton W. Welsh, same place. Filed August 29, 1895.

554,167. Car Fender and Brake. George W. Beard, Baltimore, Md., assignor of two-thirds to John W. Erdman and Charles F. Schweizer, same place. Filed December 2, 1893.

554,221. Electric Snap-Switch. Gerald W. Hart, Hartford, Conn., assignor to the Hart & Hegeman Manufacturing Company, same place. Filed September 27, 1894.

ELECTRICAL AGE

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CONTENTS.

FEBRUARY 22.

George Washington would have been 164 years old to-day if he had lived until now.

MUCH IN LITTLE.

A ship was recently destroyed at sea by fire, and the fact was announced in a cipher cablegram containing these words: "Smouldered, hurrah, hallelujah." Translated, the despatch read: "The ship has been destroyed by fire, crew saved by boats—all hands saved." This is what might be called highly concentrated essence of expression by telegraph.

NIAGARA FALLS DRY!

Niagara Falls ran almost dry a few days ago during the heavy storm. Such a condition was never known before, and how far it affected the power stations supply we have not heard. Having occurred once, it is liable to happen again, and the possibility of decreased water supply must receive the serious consideration of engineers and those depending upon a steady flow at this point.

THE ELECTRICAL CONVENTION AND EXPOSITION.

In about three months from the present time two important events will take place in the electrical world, *i. e.*, the convention of the National Electric Light Association, and the National Electrical Exposition. Both will be held in, it may be, the Greater New York, and will occur at a time when New York is at its best. There are always plenty of visitors in the city during May, and these, in addition to the large numbers of the residents of the Greater New York, who are active supporters of enterprises of this character, will insure a vast numerical attendance. The electrical business men appreciate these facts and are going to make the best of the opportunity to let the people know who they are and what they are doing. The indications point to a very large and successful exhibition, and there is considerable enthusiasm attending the outlook and arrangement of details. Everyone feels that the business situation is decidedly better, and they are going to help trade along all they can. There is certainly a very marked and noticeable feeling of buoyancy and hope and, judging from the general conditions, there is good reason for it. The exposition certainly will be held under the most favorable auspices.

RÖNTGEN RAYS.

The discovery of Prof. Röntgen continues to occupy the time and attention of hundreds, and probably thousands, of experimenters all over the land. In most instances the work is simply a repetition of what Prof. Röntgen had already done before he told the world of his discovery; but in a few cases further research is the impelling influence. There is yet much to learn about the mysterious rays before we can tell just what we can do with them and how to do it. Mr. Edison, Profs. Pupin, Wright, Trowbridge and others are carrying on experiments with this object in view, and we hear that some surprising things are coming. Mr. E. P. Thompson, of this city, has carried the idea a step further than any one else, in proving the possibility of seeing the motion of invisible parts, such as that of the bones, in opening and closing the hand or moving the fingers. Mr. Thompson claims that it will be possible to see the motion of the internal structures of fishes, frogs, etc., by his method, which is, however, but a logical sequence of Prof. Röntgen's discovery. It is indeed surprising what an amount of information Prof. Röntgen imparted to the world in his now famous communication. He had gone over the ground very thoroughly and made sure of his position in the premises before the arrival of the time to make the announcement. His original paper is so clear in its statements, so straight to the point and so comprehensive, that we think it worth the space to reproduce the English translation. This paper will become historic, and may well be taken as a guide by all experimenters.

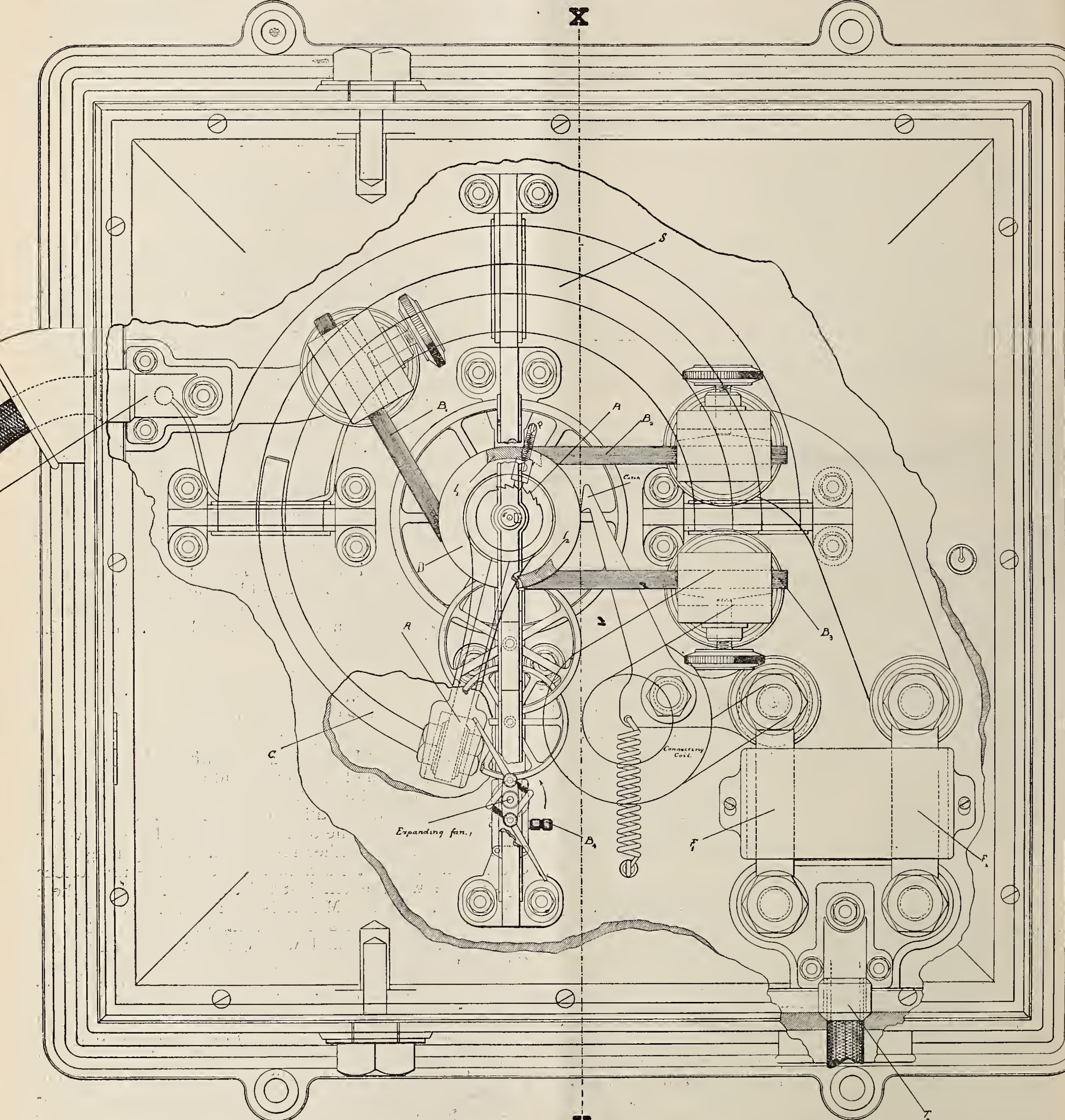
CURRENT CONTROLLER.*

For the Protection of Power Companies.

BY ERNEST K. ADAMS.

The purpose of this instrument is to prevent the consumption of electrical power beyond a certain predetermined limit, where the current is supplied by power companies. The most natural method of limiting the amount of electrical energy would be by means of a fuse, whose capacity would be limited to the existing conditions. This is objectionable, however, on account of the probability of motors being connected to the supply mains, in addition to other apparatus which from their construction do not require more power when the current is first turned on, whereas in motors the reverse is true. It is evident that if a fuse were intended to limit a circuit beyond the power necessary for running a motor or motors, upon starting, the fuse would be "blown."

The working of this device consists briefly of the substitution of a fuse calculated for running purposes for a fuse rated for starting. If more current is taken after starting than has been previously arranged for, the second fuse "blows" and all current is thereby shut off.



CURRENT CONTROLLER.

The instrument is principally made up of the following parts:

A solenoid (S) in which a core (C) moves. This rod is supported by an arm (A) which is keyed on the shaft (s), as is also the intermediate drum (D). This drum has let in on its circumference two porcelain insulating segments

* *Yale Scientific Monthly*, February 1896.

(I_1), and (I_2) placed at opposite ends of a vertical diameter, and serves to allow a current to pass from the brush (B_1), to either of the brushes (B_2) or (B_3), depending on the position of the arm (A). When there is no current passing through the instrument this arm is normally in the position as represented by the drawing. This allows a current, after having divided at (T_1); a very small per cent. going through the solenoid which is in shunt, on account of its relatively high resistance, to pass from the brush (B_1), through the drum and by way of brush (B_2), through fuse (F_2) which is calculated for starting, and then out at (T_2). From the moment that the current is turned on, the core (C) is slowly pulled into the solenoid. This is obliged to continue slowly, as the vertical pawl (P), on the top of the arm, engages the ratchet (R) and thereby compels the train of gears, with the expanding fan at the end, to be brought into play. This action places the upper brush (B_2) out of contact with the drum, and, at the same time, brings into contact the lower brush (B_3) and through this the current passes to fuse (F_1), which is suitable for running, and then out. The time that is taken for this substitution to take place may be made equal to the interval required by the motor to attain its speed, by varying either the size of the wire in the solenoid, or the pressure of the brake, or by both.

When the motor is shut down the solenoid, ceasing to act, allows the arm by its own weight to return to its original position, thereby bringing the drum also back to its starting-place. The device is then prepared to furnish enough current for starting up again.

If more current is used than is intended, the fuse ($F_{1 \text{ or } 2}$) blows and allows the angle lever to be drawn down by the spring, and the end of this lever, engaging in the drum, prevents any retrograde motion and thereby shuts off all further current until the fuse is replaced.

This device is designed for power companies selling 24 horse-power, and is to protect them from an excess of current being taken over and above the amount contracted for. The same result that this is intended to accomplish might be obtained by the use of extra large wattmeters. This arrangement would necessitate, however, a continued visiting of inspectors who would be obliged to take readings and compare with lawful figures, in order to see that the proper quantity of power was being used. The controller would not require any attention whatever, until an over amount was attempted, and in that case the power company would have to be notified, in order to have further electrical supply.

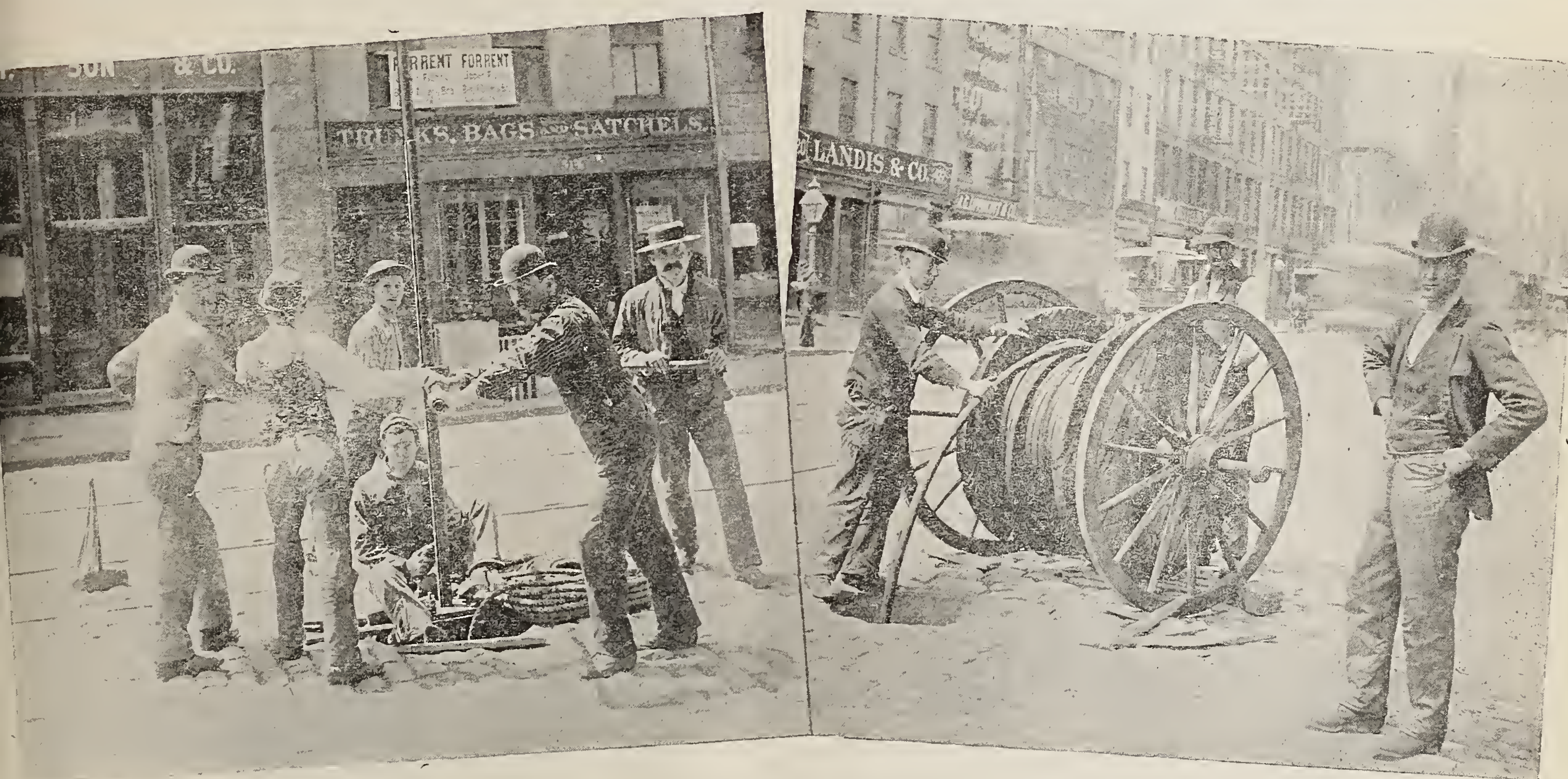
THE NATIONAL UNDERGROUND CABLE COMPANY.

This company, backed by money, experience and reputation, has recently entered the field of underground cable work. The new company is now manufacturing underground cables for all purposes, both high and low tension. The insulating material used on the National cables is paper of the highest quality best suited for the purpose. Paper insulation is among the best known, and when the paper is treated by the special process employed it is rendered proof against moisture, gas, acids, etc., and at the same time it is made a very high insulator.

The National Underground Cable Company is controlled by the National Conduit Manufacturing Company, Times Building, New York, both concerns jointly occupying the same offices. They have already received some large orders for their new cables from many of the various telephone, electric light and power companies. and there is every indication that the paper insulated cables will attain the position in the esteem of the trade that their worth merits. The new cables are being manufactured under the patents, and at the factory, of the Norwich Insulated Wire Company.

The combination of a first-class conduit with first-class cables is what the large electrical companies are eagerly looking for.

The accompanying illustration shows the process of drawing in the National Underground Cable Co.'s cables through the conduits of the National Conduit Manufacturing Co.



PROCESS OF DRAWING IN NATIONAL UNDERGROUND CABLES.

The Photographic Times for March devotes quite a number of its pages to the important discovery by Prof. Roentgen. Mr. Max Osterberg, E.E., A.M., contributes an interesting article upon the subject, illustrated by some "skotographs," as he calls them, of objects enclosed in an aluminium case. Illustrations are also given of Prof. Wright's experiments with Roentgen rays, and a translation of the report of Prof. Roentgen himself. The rest of the issue is made up with some fine articles and illustrations.

PRINCIPLES OF DYNAMO DESIGN.

BY

Newton Harrison E.E.

(*Continued from page* 76.)

Rule for Series Winding of Drums.

For series winding the number of inductors, spacing and poles must bear the following relation to each other:

I = inductors,
S = spacing (always an odd number),
p = *number of poles.*

$$I = S \times p \pm 2.$$

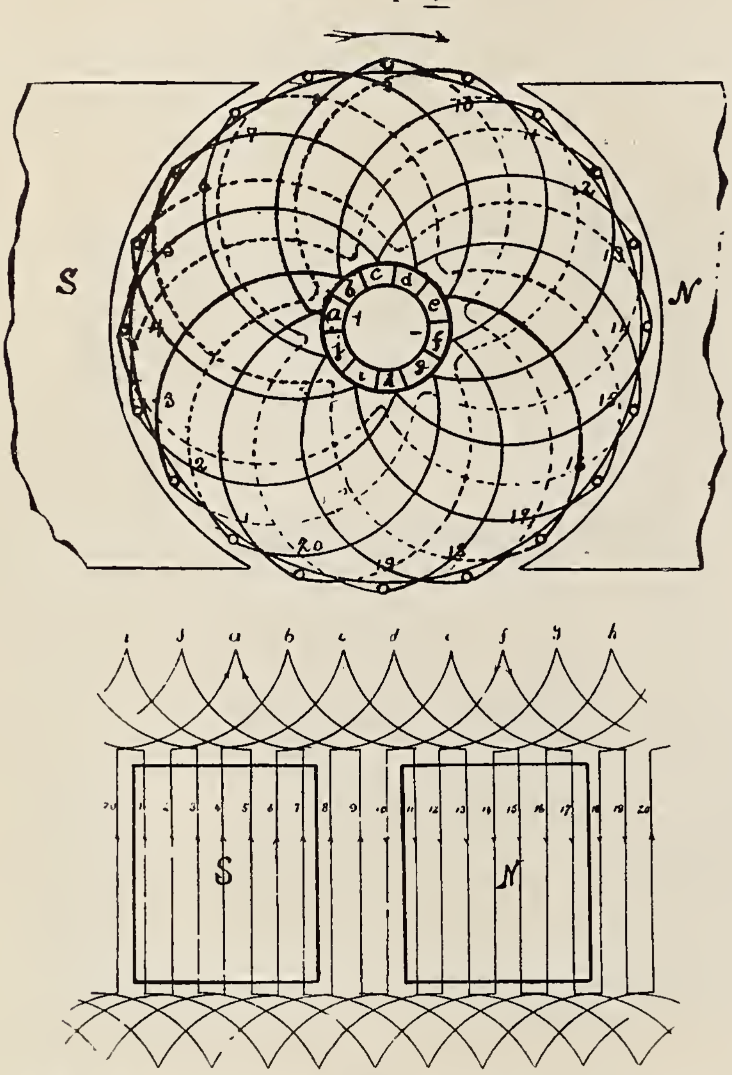


TABLE FOR 20 INDUCTOR BIPOLAR DRUM WAVE WOUND.

$$a = P \qquad \text{Spacing} = \frac{I}{P}\left(\frac{I}{T} \pm a\right)$$

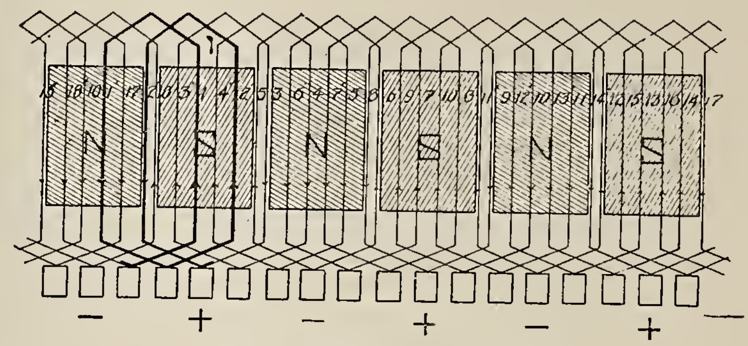
$$9 \text{ or } 11 = 1 \times \left(\frac{20}{2} \pm 1\right)$$

For even connectors at each end wind 1 to 10 and 1 to 12.

S = 11	F	B	F
a	20	11	b
b	2	13	c
c	4	15	d
d	6	17	e
e	8	19	f
f	10	1	g
g	12	3	h
h	14	5	i
i	16	7	j
j	18	9	a

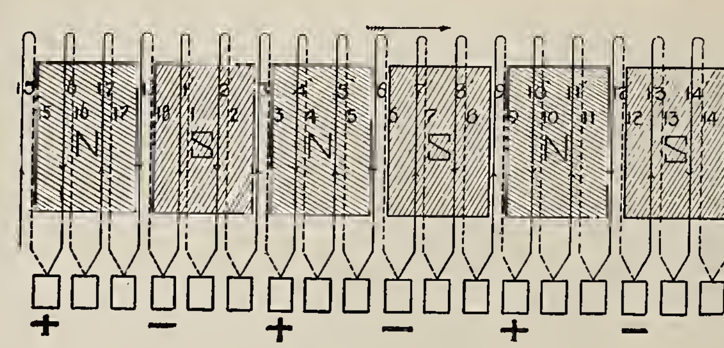
Taking a case in which the parts are as follows, the inductors will be:

$$S = 7$$
$$p = 6 \therefore I = 7 \times 6 \pm 2$$
$$= 44 \text{ or } 40.$$



LAP WINDING—MULTIPLE.

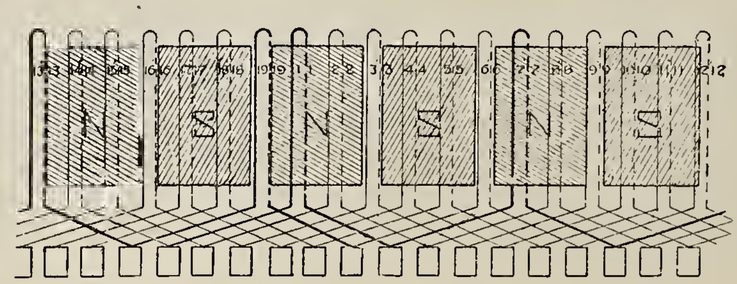
For *multiple winding* the sections and poles are a multiple of each other. If the number of poles are four and the sections are to be determined, they must be either four, eight, twelve, etc., in order that they may be in accordance with the rule. If the number of poles is four and the sections 44, the multiple is odd; but still there exists a



WAVE WINDING—SERIES.

parallel set of connections, which prevent instantaneous commutation at all the brushes because first the positive and then the negative brushes collect alternately.

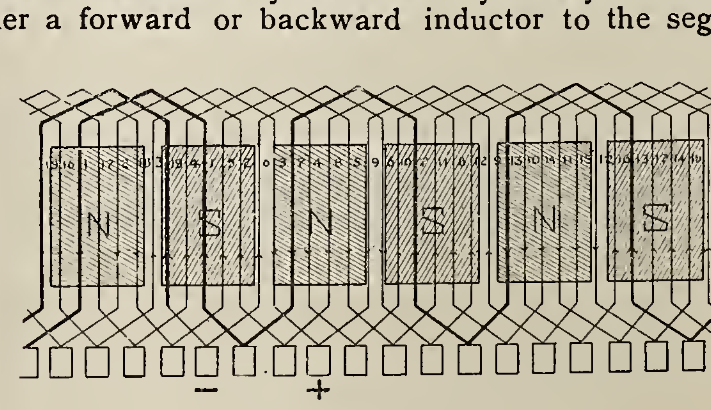
The common practice of today calls for slotted armatures. The convenience of having the spacing always



RING WAVE WINDING—SERIES.

perfectly equidistant makes this a valuable feature in their use.

The method of connecting up to the commutator segments is satisfactorily executed by always connecting either a forward or backward inductor to the segment.



RING WINDING—MULTIPLE.

There are means at hand of removing the chance of a doubt by tagging the special inductors, and thus being able to connect to commutator bars without hesitation.

In the above sketches is shown the manner of connecting to bars of commutator. Both the inductors and bars are specially numbered or lettered, and thus places the relation between the two before the reader.

The better method of procedure would be the practice of trying any new winding for either bipolar or multipolar use on a cardboard disk, slotted as the armature proper would be and, with the spacing and style of winding adopted and followed from a winding table, see whether the design is satisfactory and the winding uniformly distributed.

The field is open for a variety of winding types, and one may be selected of a neat, compact and satisfactory nature.

(*To be Continued.*)

DEPARTMENT OF ELEMENTARY EDUCATION.

BY THE EDITOR.

[*Note.—Any one is invited to ask questions on any point that is not made clear in these articles. Suitable explanations will be cheerfully given under the head of "Answers to Inquiries."*]

(*Continued from Page* 78.)

ELECTRIC GAS LIGHTING.

There are three separate and distinct systems of electric gas-lighting, viz. : the pendant, the automatic, and the multiple. The first two are used in dwelling houses and the third principally in public buildings, etc., where it is required to light many burners located in inaccessible places.

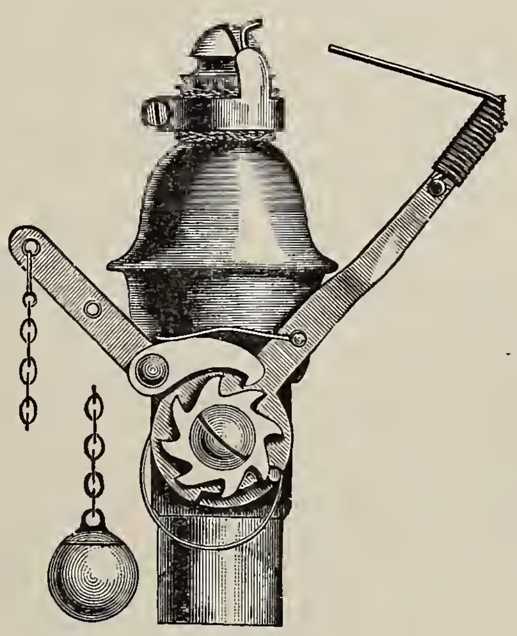


FIG. 18.

The pendant system consists of a gas burner provided with a ratchet and pawl for the purpose of operating the gas cock, to which is also attached a *movable* electrode and chain for operating it. The *fixed* electrode is placed at the tip and in line with the gas flame. It is insulated from the burner, and connected with the battery wire, as shown in Fig. 18.

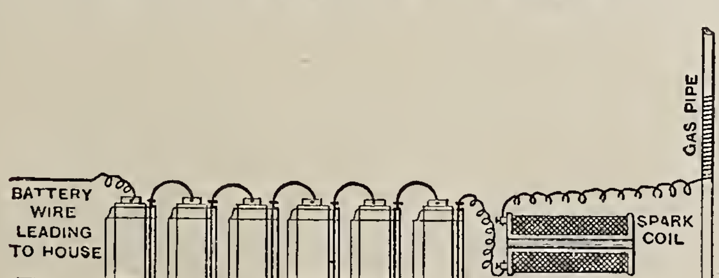


FIG. 20.

The pendant burner is so arranged that when the chain is pulled down the gas is turned on, and at the same time the movable electrode comes into contact with the platinum point of the fixed electrode, along which the movable electrode passes until it slips off, thus breaking the contact. When the contact is broken an electric spark is generated which, occurring as it does right over the gas tip, ignites the escaping gas. In order to extinguish the gas all that is necessary is to pull the chain again, which turns off the gas. It is evident, therefore, that every alternate pull on the chain lights or extinguishes the gas.

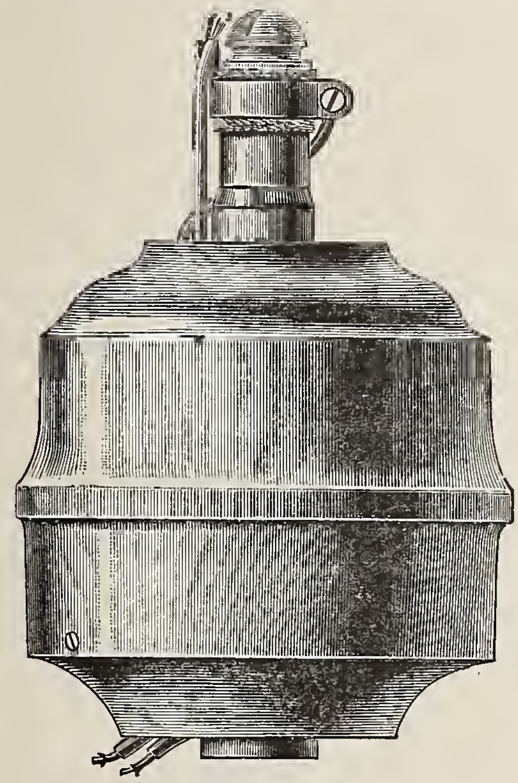


FIG. 19.

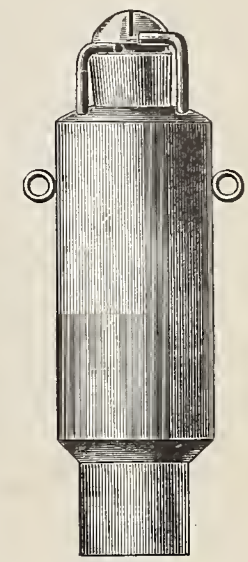


FIG. 23.

In the automatic system provision is made to light the gas at a burner by simply pushing a button at any distant point. The burner is provided with an electromagnet which operates the gas-cock and, after turning on the gas, ignites it, just as was done with the pendant chain. (See Fig. 19) It is this feature that gives the system the name "automatic."

The automatic system is especially applicable in lighting private halls, bedrooms, basements, etc. For instance,

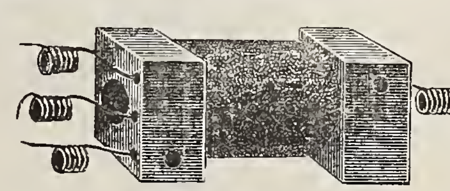


FIG. 21.

an automatic burner placed in the front hall could be lighted from a push-button placed on the door frame, on entering the house, by simply pushing the button; or, with an automatic burner in the cellar and the push-button at the head of the cellar stairs, the cellar could be instantly lighted up by pressing the button on descending the stairs. On returning, the light is extinguished by the same operation.

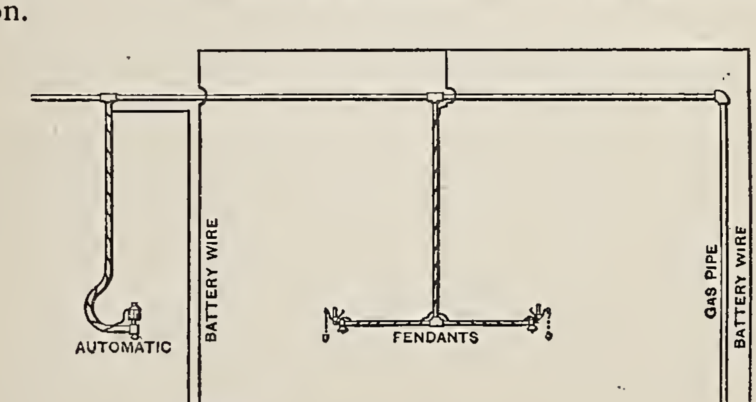


FIG. 20.

Double push-buttons permit of lighting or extinguishing two lights in different parts of the building from one point.

The location of push-buttons is entirely a matter of convenience, governed by circumstances.

Any number of push-buttons may be connected to operate one burner. Where two or more are thus connected they are arranged in multiple, the "open-circuit" system being used for pendant and automatic gas lighting.

Nearly all automatic electric gas burners are similar in construction and size, and require for their operation two wires—one to turn on the light and the other to extinguish it. There is one make of automatic burner, however, that requires only one wire to accomplish the same results.

The pendant burner is more convenient for chandeliers and side lights.

The apparatus used for gas lighting for a moderate-sized house consists of six cells of any good, open-circuit battery and a spark-coil. The cells of battery are connected in series as shown in Fig. 20, and the spark-coil (Fig 21) is connected in series with the battery.

The purpose of the spark-coil is to deliver a sufficiently large spark at the burner, when the movable electrode breaks contact with the fixed electrode, to ignite the gas. Without the spark-coil the spark due to the battery current alone would not be sufficient for the purpose. The spark-coil, it is of course understood, does not send out the spark; its action in the circuit is to generate what is called "extra" or "self-induced" current. This extra current has a much higher electromotive force than the battery current, and manifests itself in a marked degree when the current is broken at any point by producing a spark at that point. In gas lighting it is arranged to break the current right over the gas-jet—just where the spark is needed.

The current generated by the spark-coil, being of high

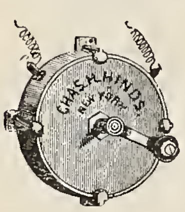


FIG. 26.

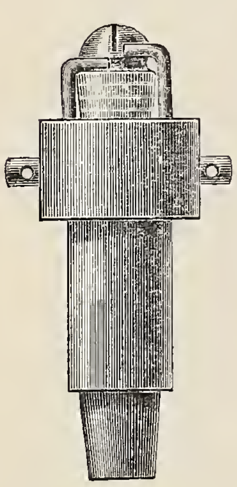


FIG. 24.

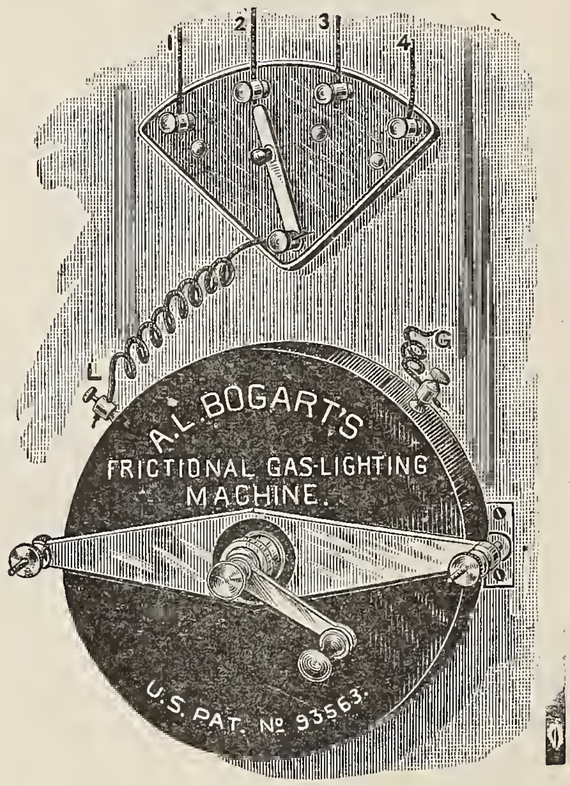


FIG. 25.

electromotive force, will jump considerable of a gap to seek a path of lower resistance than that offered by the wire itself. Therefore great care must be taken to have the wire thoroughly insulated, and free from any weak spots, where the current might be diverted from its legitimate path. Particular care should be taken where the wires run in close proximity to gas pipes, because the ground connection of the pipes offers very great inducements to the current to depart from its path of duty. All splices in the wire should be well made, soldered, if possible, and afterwards bound with insulating tape.

Usually the battery and spark-coil are placed in the cellar. But if the cellar is not a fairly dry one it is not the best place for any battery. Always provide a dry location for the battery—in the cellar, wood-shed, in a closet, in the garret, or anywhere else, keeping in view at the same time accessibility and convenience.

In wiring for electric gas lighting the custom is to start a wire from one pole of the battery, making a general circuit throughout the house, to include the points where the burners that we wish to reach are located. Branch wires are run from this main circuit to the different pendants. The gas pipe is used as the return circuit by connecting the fixed electrode with the pipe, the movable one representing the end of the branch wire from the main circuit. The other end of the battery is connected to one post of the spark coil, the other post being connected with the gas pipe as shown in Fig. 22. In making the connection between wire and pipe the pipe should be filed and made clean and bright, and about three or four feet of wire should be bared of its insulation, thoroughly cleaned and firmly wound around the pipe. The connection should be made on the house side of the gas meter—that is, the side of the meter furtherest away from the street.

In Fig. 22 the wiring is for two pendants and one automatic burner, and the arrangement of the circuits and the connections of the same will be readily understood.

The multiple system of lighting, as has already been stated, is for the purpose of instantaneously lighting a large number of gas jets in such places as churches, theatres, halls, etc., where large chandeliers are hung from a high ceiling. There are two methods of lighting on the multiple system; one is by the use of a battery and an induction coil, to increase the electromotive force, and the other is by the use of frictional machines, which generate current by friction, thus dispensing with the use of battery and induction coil.

The apparatus necessary for the multiple system operated by battery current consists of a key, a circuit breaker and a circuit switch, besides the battery and induction coil. The induction coil should be provided with a condenser. The burner tips are usually made of lava and are provided with two platinum points placed in such a manner that the spark must jump through the gas. (See Fig. 23.) It is customary to connect the burners in groups, all of the burners in each group being connected in series. On the fixtures No. 24 to 27 bare copper wire is used, the wire running from tip to tip without touching any part of the fixture itself. Only at one point can the bare wire touch the gas pipe and that point is just beyond the last gas jet, where the connection is made with the gas pipe as the return wire. In some cases it may be difficult to avoid contact between wire and gas fixture. Under such circumstances the wire may be insulated for a sufficient length to avoid the difficulty. As the current used in this system is of high electromotive force, it possesses a tendency to jump across spaces where less resistance is offered to its flow; proper and careful insulation is therefore essential.

Each group of burners is controlled by a stop-cock, which should be located close to the operating mechanism. This enables the operator to turn on the gas at the moment he wishes to light the same—first turning on the gas and then sending the electric spark through the jets, thus igniting the gas. The current is sent through the wires by closing the key for an instant at the proper moment.

The frictional machine, of which illustrations are shown in Figs. 25 and 26, are practically a static machine. They generate static electricity by the friction of a hard-rubber disk against another substance. The electricity thus generated is accumulated in a condenser, which forms part of the machine, and after a few revolutions of the handle the accumulated electricity is discharged into the circuit to be lighted. The switch shown at the top of the illustration (Fig. 25) connects the machine with the different circuits. When one circuit has been lighted up the switch is turned to the next one, the handle is turned a few times and charge turned on, and so on with all the circuits.

The burners shown in Figs. 23 and 24 are constructed for this system. The spark jumps across the space between the two ends of the wires and ignites the escaping gas.

Friction machines are made of different capacities, according to the number of burners to be lighted. This system of lighting is much preferred to the other for the reason that it is simpler in mechanism, installation and operation.

—Belting enables almost any desired ratio in speed to be obtained in a convenient and simple manner.

ON A NEW KIND OF RAYS.*

BY PROF. W. C. RÖNTGEN.

1. A discharge from a large induction coil is passed through a Hittorf's vacuum tube, or through a well-exhausted Crooke's or Lenard's tube. The tube is surrounded by a fairly close-fitting shield of black paper; it is then possible to see, in a completely darkened room, that paper covered on one side with barium platinocyanide lights up with brilliant fluorescence when brought into the neighborhood of the tube, whether the painted side or the other be turned towards the tube. The fluorescence is still visible at two metres distance. It is easy to show that the origin of the fluorescence lies within the vacuum tube.

2. It is seen, therefore, that some agent is capable of penetrating black cardboard which is quite opaque to ultra-violet light, sunlight or arc-light. It is therefore of interest to investigate how far other bodies can be penetrated by the same agent. It is readily shown that all bodies possess this same transparency, but in very varying degrees. For example, paper is very transparent; the fluorescent screen will light up when placed behind a book of a thousand pages; printer's ink offers no marked resistance. Similarly the fluorescence shows behind two packs of cards; a single card does not visibly diminish the brilliancy of the light. So, again, a single thickness of tinfoil hardly casts a shadow on the screen; several have to be superposed to produce a marked effect. Thick blocks of wood are still transparent. Boards of pine two or three centimetres thick absorb only very little. A piece of sheet aluminium, 15 mm. thick, still allowed the X-rays (as I will call the rays, for the sake of brevity) to pass, but greatly reduced the fluorescence. Glass plates of similar thickness behave similarly; lead glass is, however, much more opaque than glass free from lead. Ebonite several centimetres thick is transparent. If the hand be held before the fluorescent screen, the shadow shows the bones darkly, with only faint outlines of the surrounding tissues.

Water and several other fluids are very transparent. Hydrogen is not markedly more permeable than air. Plates of copper, silver, lead, gold and platinum also allow the rays to pass, but only when the metal is thin. Platinum, .2 mm. thick allows some rays to pass; silver and copper are more transparent. Lead, 1.5 mm. thick, is practically opaque. If a square rod of wood 20 mm. in the side be painted on one face with white lead, it casts little shadow when it is so turned that the painted face is parallel to the X-rays, but a strong shadow if the rays have to pass through the painted side. The salts of the metal, either solid or in solution, behave generally as the metal themselves.

3. The preceding experiments lead to the conclusion that the density of the bodies is the property whose variation mainly affects their permeability. At least no other property seems so marked in this connection. But that the density alone does not determine the transparency is shown by an experiment wherein plates of similar thickness of Iceland spar, glass, aluminium and quartz were employed as screens. Then the Iceland spar showed itself much less transparent than the other bodies, though of approximately the same density. I have not remarked any strong fluorescence of Iceland spar compared with glass (see below, No. 4).

4. Increasing thickness increases the hindrance offered to the rays by all bodies. A picture has been impressed on a photographic plate of a number of superposed layers of tinfoil, like steps, presenting thus a regularly increasing thickness. This is to be submitted to photometric processes when a suitable instrument is available.

5. Pieces of platinum, lead, zinc and aluminium foil were so arranged as to produce the same weakening of the effect. The annexed table shows the relative thickness and density of the equivalent sheets of metal.

	Thickness.	Relative thickness.	Density.
Platinum	.018 mm.	1	21.5
Lead	.050 "	3	11 3
Zinc	.100 "	6	7.1
Aluminium	3.500 "	200	2.6

From these values it is clear that in no case can we obtain the transparency of a body from the product of its density and thickness. The transparency increases much more rapidly than the product decreases.

6. The fluorescence of barium platinocyanide is not the only noticeable action of the X-rays. It is to be observed that other bodies exhibit fluorescence, *e. g.* calcium sulphide, uranium glass, Iceland spar, rock salt, etc.

Of special interest in this connection is the fact that photographic dry plates are sensitive to the X-rays. It is thus possible to exhibit the phenomena so as to exclude the danger of error. I have thus confirmed many observations originally made by eye observation with the fluorescent screen. Here the power of the X-rays to pass through wood or cardboard becomes useful. The photographic plate can be exposed to the action without removal of the shutter of the dark slide or other protecting case, so that the experiment need not be conducted in darkness. Manifestly, unexposed plates must not be left in their box near the vacuum tube.

It seems now questionable whether the impression on the plate is a direct effect of the X-rays, or a secondary result induced by the fluorescence of the material of the plate. Films can receive the impression as well as ordinary dry plates.

I have not been able to show experimentally that the X-rays give rise to any calorific effects. These, however, may be assumed, for the phenomena of fluorescence show that the X-rays are capable of transformation. It is also certain that all the X-rays falling on a body do not leave it as such

The retina of the eye is quite insensitive to these rays; the eye placed close to the apparatus sees nothing. It is clear from the experiments that this is not due to want of permeability on the part of the structures of the eye.

7. After my experiments on the transparency of increasing thicknesses of different media, I proceeded to investigate whether the X-rays could be deflected by a prism. Investigations with water and carbon bisulphide in mica prisms of 30° showed no deviation either on the photographic or the fluorescent plate. For comparison, light rays were allowed to fall on the prism as the apparatus was set up for the experiment. They were deviated 10 mm. and 20 mm. respectively in the case of the two prisms.

With prisms of ebonite and aluminium I have obtained images on the photographic plate which point to a possible deviation. It is, however, uncertain, and at most would point to a refractive index 1.05. No deviation can be observed by means of the fluorescent screen. Investigations with the heavier metals have not as yet led to any result, because of their small transparency and the consequent enfeebling of the transmitted rays.

On account of the importance of the question it is desirable to try in other ways whether the X-rays are susceptible of refraction. Finely-powdered bodies allow in thick layers but little of the incident light to pass through, in consequence of refraction and reflection. In the case of the X-rays, however, such layers of powder are for equal masses of substance equally transparent with the coherent solid itself. Hence we cannot conclude any regular reflection or refraction of the X-rays. The research was conducted by the aid of finely-powdered rock salt, fine electrolytic silver powder and zinc dust, already many times employed in chemical work. In all these cases the result, whether by the fluorescent screen or the photographic method, indicated no difference in transparency between the powder and the coherent solid.

It is, hence, obvious that lenses cannot be looked upon as capable of concentrating the X-rays; in effect, both an ebonite and a glass lens of large size prove to be without action. The shadow photograph of a round rod is darker in the middle than at the edge; the image of a cylinder

*From the translation in *Nature*, by Arthur Stanton, from the *Sitzungsberichte der Würzburger Physik-medic. Gesellschaft*, 1895.

filled with a body more transparent than its walls exhibits the middle brighter than the edge.

8. The preceding experiments and others which I pass over point to the rays being incapable of regular reflection. It is, however, well to detail an observation which at first sight seemed to lead to an opposite conclusion.

I exposed a plate, protected by a black paper sheath, to the X-rays, so that the glass side lay next to the vacuum tube. The sensitive film was partly covered with star-shaped pieces of platinum, lead, zinc and aluminium. On the developed negative the star-shaped impression showed dark under platinum, lead, and, more markedly, under zinc; the aluminium gave no image. It seems, therefore, that these three metals can reflect the X-rays; as, however, another explanation is possible, I repeated the experiment with this only difference, that a film of thin aluminium foil was interposed between the sensitive film and the metal stars. Such an aluminium plate is opaque to ultra-violet rays, but transparent to X-rays. In the result the images appeared as before, this pointing still to the existence of reflection at metal surfaces.

If one considers this observation in connection with others, namely, on the transparency of powders, and on the state of the surface not being effective in altering the passage of the X-rays through a body, it leads to the probable conclusion that regular reflection does not exist, but that bodies behave to the X-rays as turbid media to light.

Since I have obtained no evidence of refraction at the surface of different media, it seems probable that the X-rays move with the same velocity in all bodies, and in a medium which penetrates everything, and in which the molecules of bodies are embedded. The molecules obstruct the X-rays the more effectively as the density of the body concerned is greater.

9. It seemed possible that the geometrical arrangement of the molecules might affect the action of a body upon the X-rays, so that. for example, Iceland spar might exhibit different phenomena according to the relation of the surface of the plate to the axis of the crystal. Experiments with quartz and Iceland spar on this point lead to a negative result.

10. It is known that Lenard in his investigations on cathode rays has shown that they belong to the ether and can pass through all bodies. Concerning the X-rays the same may be said.

In his latest work, Lenard has investigated the absorption coefficients of various bodies for the cathode rays, including air at atmospheric pressure, which gives 4.10, 3.40, 3.10 for 1 cm., according to the degree of exhaustion of the gas in discharge tube. To judge from nature of the discharge, I have worked at about the same pressure, but occasionally at greater or smaller pressures. I find using a Weber's photometer that the intensity of the fluorescent light varies nearly as the inverse square of the distance between screen and discharge tube. This result is obtained from three very consistent sets of observations at distances of 100 and 200 mm.; hence air absorbs the X-rays much less than the cathode rays. This result is in complete agreement with the previously described result, that the fluorescence of the screen can be still observed at 2 metres from the vacuum tube. In general other bodies behave like air; they are more transparent for the X-rays than for the cathode rays.

11. A further distinction, and a noteworthy one, results from the action of a magnet. I have not succeeded in observing any deviation of the X-rays even in very strong magnetic fields.

The deviation of cathode rays by the magnet is one of their peculiar characteristics; it has been observed by Hertz and Lenard that several kinds of cathode rays exist, which differ by their power of exciting phosphorescence, their susceptibility of absorption and their deviation by the magnet; but a notable deviation has been observed in all cases which have yet been investigated, and I think that such deviation affords a characteristic not to be set aside lightly.

12. As the result of many researches, it appears that the place of most brilliant phosphorescence of the walls of the discharge tube is the chief seat whence the X-rays originate and spread in all directions; that is, the X-rays proceed from the front where cathode rays strike the glass. If one deviates the cathode rays within the tube by means of a magnet, it is seen that the X-rays proceed from a new point, *i. e.*, again from the end of the cathode rays.

Also for this reason the X-rays which are not deflected by a magnet cannot be regarded as cathode rays which have passed through the glass, for that passage cannot, according to Lenard, be the cause of the different deflection of the X-rays. Hence, I concluded that the rays are not identical with the cathode rays, but are produced from the cathode rays at the glass surface of the tube.

13. The rays are generated not only in glass. I have obtained them in an apparatus closed by an aluminium plate 2 mm. thick. I propose later to investigate the behavior of other substances.

14. The justification of the term 'rays,' applied to the phenomena, lies partly in the regular shadow pictures produced by the interposition of a more or less permeable body between the source and a photographic plate or fluorescent screen.

I have observed and photographed many such shadow pictures. Thus, I have an outline of part of a door covered with lead paint; the image was produced by placing the discharge tube on one side of the door and the sensitive plate on the other. I have also a shadow of the bones of the hand; of a wire wound upon a bobbin; of a set of weights in a box; of a compass card and needle completely enclosed in a metal case; of a piece of metal where the X-rays show the want of homogeneity, and of other things.

For the rectilinear propagation of the rays I have a pin-hole photograph of the discharge apparatus covered with black paper. It is faint, but unmistakable.

15. I have sought for interference effects of the X rays, but possibly, in consequence of their small intensity, without result.

16. Researches to investigate whether electrostatic forces act on the X-rays are begun, but not yet concluded.

17. If one asks, what then are these X-rays, since they are not cathode rays, one might suppose, from their power of exciting flourescence and chemical action, them to be due to ultra-violet light. In opposition to this view a weighty set of considerations presents itself. If X-rays be indeed ultra-violet light, then that light must possess the following properties.

(*a*) It is not refracted in passing from air into water, carbon bisulphide, aluminium, rock salt, glass or zinc.

(*b*) It is incapable of regular reflection at the surfaces of the above bodies.

(*c*) It cannot be polarized by any ordinary polarizing media.

(*d*) The absorption by various bodies must depend chiefly on their density.

That is to say, these ultra-violet rays must behave quite differently from the visible, infra-red and hitherto known ultra-violet rays.

These things appear so unlikely that I have sought for another hypothesis.

A kind of relationship between the new rays and light rays appears to exist; at least the formation of shadows, fluorescence, and the production of chemical action point in this direction. Now it has been known for a long time that, besides the transverse vibrations which account for the phenomena of light, it is possible that longitudinal vibrations should exist in the ether, and, according to the view of some physicists, must exist. It is granted that their existence has not yet been made clear, and their properties are not experimentally demonstrated. Should not the new rays be ascribed to longitudinal waves in the ether?

I must confess that I have in the course of this research made myself more and more familiar with this thought, and venture to put the opinion forward, while I am quite conscious that the hypothesis advanced still requires a more solid foundation.

THE ELECTRICAL EXPOSITION.

The National Electrical Exposition which is to be held in the Industrial Building, Lexington avenue, 43d and 44th streets, this city, next May, is exciting considerable interest in the electrical trades. There will be a very large display of electrical apparatus and appliances, and judging from present indications it will surpass anything of the kind ever before attempted.

While the exposition will be held under the auspices of and in connection with the Nineteenth Convention of the National Electric Light Association, it will embrace street-railway apparatus and appliances as well—in fact, it will be a general electrical exposition, just as the electrical exposition at the World's Fair was.

The Industrial Building is essentially an exhibition building, having been erected especially for such uses. Every necessity and convenience that an exhibitor generally needs are provided. Steam is furnished to exhibitors in any quantity, and so is electric current, either direct or alternating, and at any voltage.

Mr. Clarence E. Stump, general manager of the exposition, is kept busy attending to the interests of exhibitors and the other multitudinous details of this vast enterprise.

Space will be allotted to exhibitors on March 10, therefore there is not much time left for the final details.

This will undoubtedly be a great and popular show. The Industrial Building is quite as well known as Madison Square Garden, and anything going on there always attracts a crowd. It will be an excellent opportunity for manufacturers and dealers in electrical goods to come in direct contact with the public. It is intended to show the progress of electricity and its various applications, even down to the uses of Röntgen rays.

THE N. E. L. A. CONVENTION.

Mr. C. H. Wilmerding, of Chicago, president of the National Electric Light Association, is in the city. He and Secretary G. F. Porter are arranging a programme for the coming convention.

MUNICIPAL CONTROL DEFEATED.

The Canadian Supreme Court at Ottawa has dismissed the appeal of the City of Vancouver, thus upsetting the by-law passed by the rate-payers in 1894, authorizing a municipal electric lighting plant. The Vancouver council has now passed a by-law providing for the lighting of the city by the Western Electric Co.

EMPIRE MINIATURE AND DECORATIVE LAMPS.

The Empire Lamp Works, 154 and 156 West 27th street, New York, is a very busy institution. In addition to their regular line of work, *i. e.*, the manufacture of miniature and decorative incandescent lamps, they are doing a great deal of experimental work, and are also rushed in making Crooke's tubes of all sizes, for which there is now a very large demand. The company has secured a specialist for the manufacture of these tubes.

All of the Candelabra electric lamps used with such brilliant effect in Sara Bernhardt's play, "Gismonda," were furnished by the Empire Lamp Works.

The Candelabra, series and battery lamps manufactured by this company are growing more and more in demand as they become better known. The Candelabra lamps are made in five styles and of different colors. The series lamps are made to burn on electric light circuits, and the battery lamps are made for battery current only.

The company has the facilities for manufacturing special lamps in any desired quantity and in the best manner possible.

THE INVENTION OF THE LOCOMOTIVE WHISTLE.

When locomotives were first built and began to trundle their small loads up and down the newly and rudely constructed railways of England, the public roads were, for the greater part, crossed at grade, and the engine driver had no way of giving warning of his approach except by blowing a tin horn. But this, as may be imagined, was far from being a sufficient warning. One day, in the year 1833, so runs a story of the origin of the locomotive whistle, a farmer of Thornton was crossing the railway track on one of the country roads with a great load of eggs and butter. Just as he came out upon the track a train approached. The engine man blew his tin horn lustily, but the farmer did not hear it. Eighty dozen of eggs and fifty pounds of butter were smashed into an indistinguishable, unpleasant mass, and mingled with the kindling wood to which the wagon was reduced. The railway company had to pay the farmer the value of his fifty pounds of butter, his 960 eggs, his horse and his wagon. It was regarded as a very serious matter, and straightway a director of the company went to Atton Grange, where George Stephenson lived, to see if he could not invent something that would give a warning more likely to be heard. Stephenson went to work and the next day had a contrivance which, when attached to the engine boiler, and the steam turned on, gave out a shrill, discordant sound. The railway directors, greatly delighted, ordered similar contrivances to be attached to all the locomotives, and from that day to this the voice of the locomotive whistle has never been silent.—*Cassier's Magazine* for February.

New York Notes.

The Kabat Electric Co., 72 and 74 Fulton street, New York, Harry Kabat, general manager, is successor to James H. Mason. The Kabat Company manufactures Mason's primary batteries and other inventions, and handles phonographs and general electric supplies.

NEW TELEPHONE COMPANIES.

Gastonia, N. C.—A company has been formed by C. B. Armstrong to install a telephone system.

Abbeville, S. C.—The Abbeville Telephone Co. has been organized with a capital of $1,000.

Anderson, S. C.—The Anderson Telephone Co. has been incorporated by L. A. Brock and associates ; capital stock, $5,000 ; to construct telephone lines.

Sweetwater, Tenn.—A company has been formed by W. O. Rhode to establish a telephone system.

Newport News, Va.—W. E. Cottrell, J. A. Willett, J. G. Livezey and others have made application for incorporating the Richmond, Newport News and Norfolk Telephone Co. Capital stock, $40,000.

Telephone Notes.

Yarmouth, N. S.—The Yarmouth, N. S., Telephone Co. is stringing wires for the use of the Coast Railway Co., which will be operated by telephone instead of telegraph.

Manistee, Mich.—Manistee Electrical and Telephone Co. has been incorporated, with a capital stock of $50,000.

Richmond, Pa.—A local telephone line is soon to be erected between Richmond and Bangor. and another local line is to be erected between the latter place and Stone Church.

Glasgow, Ky.—Glasgow is to have a telephone exchange at an early date.

Alton, Ia.—A telephone line from Alton to Paulina is being talked of.

Columbus, Ga.—A long-distance telephone line will soon be built from here to Opelika, Ala.

Brownwood, Tex —A telephone system will be equipped by John G. Lee, for which telephone supplies are wanted.

Lansing, Mich.—The Lansing Telephone Exchange increased its capital stock from $30,000 to $60,000, and decided to erect a line to St. Johns and surrounding towns, establishing exchanges in some of the smaller towns in Central Michigan. O. D. Hardy was elected general manager to succeed D. A. Reynolds.

Bellefonte, Pa.—J. Spigelmyer, G. L. Frank, A. Walter, A. A. Frank and C. S. Musser, of Millheim, have applied to the Governor for a charter for a corporation to be known as the Millheim Electric Telephone Co. The Millheim Co. will build lines to connect the towns of Coburn, Aaronsburg, Rebersburg, Madisonburg, Spring Mills, Centre Hall and the surrounding villages with Millheim, extending the line to Bellefonte.

Fairmont, Minn.—The Fairmont Telephone Co. filed articles of incorporation with the Secretary of State. The capital stock is $25,000.

Allison, Ia —It is stated that a telephone line will be established between this point and Grundy Center, via Parkersburg, in the near future.

Leon, Ia —Leon is to have a local telephone exchange.

Carrollton, Mo —A telephone line is to be established from Winchester through Manchester, Roodhouse, White Hall and Carrollton.

Northfield, Vt.—Northfield is soon to be equipped with a new telephone service.

Barron, Wis.—A company has been organized at Barron to be known as the Barron County Telephone Co., with a capital of $2,500. The object is to connect Rice Lake, Barron, Cameron, Chetek and Cumberland by telephone. Work will be commenced at once. D. Post, Charles Bomm, W. C. Coe and others are directors.

TELEPHONE PATENTS ISSUED FEBRUARY 11, 1896.

Apparatus For Telephone Switchboards. Chas. E. Scribner, Chicago, Ill. (No. 554,399.)

New Corporations.

Aylmer, Que.—The Deschenes Electric Co., Aylmer, Que., has been incorporated to build and operate works for the distribution of electricity. R. H. and John Conroy are among the promoters.

Chicago, Ill.—Chicago Electric Sign Co.; Capital, $10,000; Incorporators, R. C. Knowles, Walter S. Holden and Forest Hopkins.

Reading, Pa.—Schuylkill Valley Electric Co. has been incorporated by Frank Howard, Christian L. Aab, B. Shepp, J. Hyde Clark, Philadelphia; Cyrus G. Derr, Reading.

Minneapolis, Minn.—The Bicycle Electric Light Co., of Minneapolis; capital, $35,000. W. H. Brown, Aug. Perrault and John Theis are the incorporators.

New Orleans, La.—The Merchants' Illuminating and Power Co. has been incorporated by J. J. Cohn and others. Capital stock, $300,000.

Nacogdoches, Tex.—The Nacogdoches Electric Light and Power Co. has been incorporated by R. C. Shindler and others. Capital stock, $10,000.

Harrisburg, Pa.—The Valley Electric Street Railway Co. of Allegheny was chartered. The length of the road will be 2¾ miles. Chas. P. Rankin is president, and the capital is $10,500.

San Francisco, Cal.—The Continental Motor and Traction Co.; principal place of business, San Francisco. Capital stock, $1,000,000; with $40,000 subscribed, and Philip Le Montague, W. R. Smedburg, G. I. Ives and W. B. Hooper, of San Francisco, as directors.

Possible Contracts.

Jersey City, N. J.—The First Troop, Newark, is to build a new armory and riding school in Roseville on Roseville avenue. The committee has adopted the plans for the building, offered by Mr. Chas. Gifford, of Jersey City. The structure will be three stories high.

New York City.—D. O. Mills, of the Mills Building, wil erect a twelve-story brick hotel at northwest corner of Rivington and Christie streets, at a cost of $200,000.

Atlantic City, N. J.—It is rumored that an electric trolley road is to be built between Atlantic City and Camden, to connect with another line stretching to Trenton, thence through Newark and New York. It is said that the stock has all been subscribed and the capitalization is placed from $1,000,000 to $5,000,000. A charter is being prepared for presentation to the New Jersey Legislature.

Rochester, N. Y. —Sidney B Roby will erect a six story building on Elizabeth street early in the spring. The structure will cost upwards of $40,000, and will be absolutely fire-proof. The building is to be erected for the Van Berg Silver Plate Co.

New York City.—The Police Board approved of a bill drawn by Commissioner Andrews providing for the establishment of a police signal system.

Newark, N. J.—Extensive improvements will soon be made to the Continental Hotel, at Broad and Division streets. Plans have also been drawn for a six-story addition to the hotel on the south. The improvements will be done after plans furnished by Paul G. Botticher, architect.

Toledo, O.—The directors of the Hotel Madison Co. have decided to build a six-story addition to the present building. The new structure will be fireproof.

Johnstown, Pa.—It is stated that the Johnson Co. will begin the erection of a large hotel at Moxham.

Niles, O.—Daniel Monahan, owner of the Mineral Ridge and Niles Electric Street Railway, is going to extend his line to Youngstown.

Mt. Vernon, N. Y.—A large warehouse is shortly to be erected for Valentine & Co. in Sixth avenue. The architect is W. H. A. Horsfall.

New York City.—Lachman, Morgenthau & Goldsmith, Tribune Building, will erect a six-story brick store on 6th avenue, corner of 19th street, to cost $200,000.

Meriden, Conn.—Preparations are now being made for the erection of another large block in Meriden. Ex-Sewer Superintendent George W. Williams is to put up a four-story building on the property on the east corner of West Main street and Linsley avenue. The plans are now being drawn by Architect Bloomfield.

Port Jefferson, L. I.—The Port Jefferson Electric Light Co. has purchased a lot on Water street and will erect a brick building for a power house.

Saratoga, N. Y.—It is reported that Wolley & Gerrans, proprietors of the Grand Union Hotel in this village, have entered into a contract for the construction of a $3,000,000 650-room hotel in New York City.

Bowling Green, Ky.—Information as to the cost of motors, dynamos, insulated wire, electric fans, cooking and heating apparatus, is wanted by M. H. Crump.

Richmond, Va.—A $50,000 company is to be formed to erect a theatre. Address Mr. Leath, manager of the Academy.

New York City.—Plans are being prepared by Architect J. B. Baker, 154 Fifth avenue, for the National Bank of Commerce, northwest corner of Nassau and Cedar streets, for the erection of an 18 story fire-proof skeleton construction, bank and office building, to cost about $250,000. The building will be 104x108 feet in dimensions. The first four stories will be of gray granite and the upper stories of light brick and terra-cotta.

New York City.—The Demas Barnes property at 21 Park Row, opposite the Post-Office, has been sold by the estate to a syndicate, represented by William N. Ivins. The property runs through to Theatre Alley. It is understood that the purchasers will erect a 25-story office building upon the site. It is expected that the demolition of the old building will soon be begun.

Indianapolis, Ind.—The Grand Hotel will be enlarged. The new building will be five stories in height and will cost about $65,000.

New York City.—The house at Fifth avenue and 57th street has been leased to Herman Oelrichs, who will have plans prepared by Architects McKim, Mead & White, to make alterations to same to cost about $50,000.

New York City.—A three-story iron storage house is to be erected by R. Hoe & Co., 504 Grand street, at a cost of $10,000.

Cheboygan, Mich.—George Silsby, head of the rapid transit electric line between Bay City and Saginaw, is contemplating turning the street railroad line into an electric road and extending it to inland lakes.

Dallas, Tex.—The Dallas City Street Railway Co. propose to erect a power plant.

Hamilton, Ont.—The Lincoln County Council has granted the Hamilton, Grimsby and Beamsville Electric Railway a twenty year franchise for running power over the Queenston and Grimsby stone road, and work will be commenced at once to build the extension from Grimsby to Beamsville.

Cornwall, Ont.—Cornwall is to have an electric street railway. The contractors are W. Harper, of New York, and D. H. Star, of Montreal.

Brockville, Ont.—There is a movement on foot to connect Kingston, Gananoque, Rockport and Brockville, Ont., by an electric railway.

Toronto, Ont.—The Toronto and Suburban Electric Railway is completing plans for extending its line to Lambton and Islington, a distance of three miles beyond the present terminus.

London, Ont.—A St. Thomas gentleman is said to be negotiating for the purchase of the St. Thomas Street Railway from Hunt & Cameron, of London, Ont. A price has been set on the franchise and it is not unlikely that the road will pass into new hands on the first of March.

The Manitoulin and Pacific Railway Co. is making application for an Ontario charter to build an electric railway from a point in Manitoulin Island to a junction with the Canadian Pacific Railway between Sudbury and Algoma Mills, with power to operate a ferry or build a bridge at Little Current.

Belleville, Ont.—The County Council have granted permission to the Belleville Traction Co. to construct an electric railway one and one-half miles in length from the city limits westward.

FINANCIAL.

The Bridgeport Traction Company reports gross earnings for January of $21,896, an increase of $3,121 as compared with the same month of last year, and net $8,724, an increase of $3,350.

Trade Notes.

Darling, Brown & Sharpe, Providence, R. I., have issued a neat little pamphlet on standard and tempered rules. The tempered rules are as accurately graduated as the standard or soft rules. These rules are made in all graduations, and are excellent for draughtsmen and general use. Their accuracy commends them.

ELECTRICAL and STREET RAILWAY PATENTS

Issued February 11, 1896.

554,230. Regulating Phase Relation of Alternating Currents. Ernst J. Berg, Schenectady, N. Y., assignor to the General Electric Company, of New York. Filed October 8, 1895.

554,239. Method of Transferring Feeders. James Burke, Schenectady, N. Y., assignor to the Thomson-Houston Electric Company, Boston, Mass. Filed Dec. 24, 1894. Renewed Jan. 6, 1896.

554,240. Method of Electrical Distribution. James Burke, Schenectady, N. Y., assignor to the Thomson-Houston Electric Company, Boston, Mass. Filed Dec. 24, 1894. Renewed Jan. 6, 1896.

554,245. Means for Supporting and Moving Electric Lamps. James Dempsey, Berlin, Conn., assignor to the Berlin Iron Bridge Company, same place. Filed April 1, 1895.

554,247. Battery. Walter S. Doe, Brooklyn, N. Y., assignor of one-half to Henry Thompson, same place. Filed Sept. 18, 1894. Renewed June 6, 1895.

554,263. Electric Cable. Theodore Guilleaume, Mülheim-on-Rhine, Germany. Filed Mar. 19, 1895, Patented in England Nov. 1, 1893, No. 20,698; in Belgium Nov. 10, 1893, No. 107,113; in France Nov. 11, 1893, No. 233,988; in Austria Mar. 26, 1894, No. 2,313, and in Hungary Mar. 26, 1894, No. 1,112.

554,270. Three-Wire Electric System. Edward M. Hewlett and William B. Potter, Schenectady, N. Y., assignors to the General Electric Company, of New York. Filed Sept. 10, 1895.

554,275. Method of and Means for Detecting Grounds. Jonn F. Kelly, Pittsfield, Mass., assignor of one-half to Cummings C. Chesney, same place. Filed June 17, 1895.

554,276. Controller for Dynamo-Electric Machines. Walter H. Knight, Lynn, Mass., and John W. Darley, Jr., Baltimore, Md. Filed May 6, 1893.

554,301. Car-Fender. Herbert Parpert, St. Louis, Mo. Filed June 6, 1895.

554,307. Controller for Electric Motors. William B. Potter, Schenectady, N. Y., assignor to the General Electric Company, of New York. Filed Aug. 5, 1895.

554,321. Electrical Measuring Instrument. Elihu Thomson, Swampscott, Mass., assignor to the General Electric Company, of New York. Filed Nov. 12, 1895.

554,332. Insulating-Joint. George J. Carson, Chicago, Ill. Filed Sept. 23, 1895.

554,350. Trolley and Switch for Electric Railways. Lorenzo L. Stimpson, Boston, Mass., assignor of one-half to Frederic Cunningham, same place. Filed May 2, 1890.

554,353. Electric Locomotive. Charles F. Uebelacker, Cleveland, Ohio, assignor to Sidney H. Short, same place. Filed Sept. 6, 1893.

554,365. Electric Motor. John H. Guest, Boston, Mass. Filed Dec. 23, 1893.

554,369. Commutator-Brush. Osborne P. Loomis, Bound Brook, N. J. Filed Feb. 13, 1895. Renewed Oct. 17, 1895.

554,379. Electric-Light Cabinet. Eason L. Slocum, Pawtucket, R. I. Filed Mar. 21, 1895.

554,394. Insulating-Joint. Louis McCarthy, Boston, Mass. Filed Oct. 14, 1895.

554,395. Telegraph-Receiver. Louis E. Oehring, Chicago, Ill., assignor to the Western Electric Company, same place. Filed July 20, 1893.

554,399. Apparatus for Telephone-Switchboards. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed July 2, 1895.

554,414. Automatic Current-Regulator. Stanley C. C. Currie, New York, N. Y., assignor to himself and Edward N. Dickerson, same place. Filed May 23, 1895.

554,427. Voltaic Battery. Stanley R. V. Robinson, Brooklyn, N. Y. Filed May 9, 1895.

554,437. Railway-Switch. William M. Brown, Johnstown, Pa. Filed Nov. 14, 1894.

554,438. Distributing-Box and Fuse-Plug. Percy S. Brown, Toledo, Ohio. Filed Apr. 19, 1895.

554,450. Underground Conduit for Electric Railways. William S. Merkle, St. Louis, Mo. Filed Mar. 29, 1894.

554,459. Electric-Lamp Holder for Bicycles. Edward D. Rockwell, Bristol, Conn. Filed May 10, 1895.

554,462. Car-Fender or Guard Henry Schweers, New York, N. Y. Filed July 10, 1895.

554,487. Car-Fender. Willis D. Gold, Philadelphia, Pa. Filed Oct 22, 1895.

554,495. Automatic Car-Fender. Daniel F. Manning, Troy, assignor of three-fifths to Edward McCreary, Geo. H. Fitts, and Alfred Blyth, Cohoes, N. Y. Filed Jan. 11, 1895.

554,505. Electrical Burglar-Alarm. Clyde Coleman, Chicago, Ill., assignor of two-thirds to Albert L Deane and James W. Donnell, same place. Filed Nov. 20, 1895.

554,508. Automatic Cut-Out for Electrical Converters. William J. Greene, Cedar Rapids, Iowa. Filed Sept. 30, 1895.

554,525. Attachment for Car-Fenders. Robert Muir, Brooklyn, N. Y. Filed Dec. 13, 1895.

554,541. Machine for Connecting Electric Conductors. Harlie J. Savory, Somerville, Mass. Filed Apr. 17, 1893.

554,542. Electric-Arc Lamp. John A. Seaverns, Boston, Mass. Filed May 14, 1895.

554,557. Electric Switch. Henry B. Whitehead, Memphis, Tenn. Filed Aug, 29, 1894.

554,571. Trolley Guard. John H. Beazan, Milwaukee, Wis., assignor of three-fifths to Moritz M. Meissner and Samuel S. Weil, same place. Filed Mar. 19, 1894.

554,594. Electric Type-Writer Machine. John L Garber, Sidney, Ohio. Filed Dec. 26, 1892.

554,617. Armature for Induction-Motors. Abe L. Cushman, Concord, N. H. Filed Mar. 30, 1895.

554,622. Electric Gas-Lighter. Harry G. Grier, Philadelphia, Pa., assignor to the Grier-Young Electric Company, Camden, N. J. Filed Nov. 7, 1895.

554,631. Conduit for Electric Conductors. Frank Fuller and John M. Kinney, Boston, Mass. Filed May 24, 1895.

554,632. Electric Heater or Rheostat. Frank Kraemer and Max Kruger, Chicago, Ill. Filed Jan. 7, 1895.

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CONTENTS.

STANDARD WIRING RULES.

The necessity for uniform wiring rules has long been recognized by electrical engineers and insurance underwriters, and it is proposed to hold in this city, on March 18, a meeting of representatives of the interests concerned for the interchange of views on this important subject. Mr. W. J. Hammer, chairman of the committee of the National Electric Light Association, in this issue presents the matter in its true light and ably argues the cause of uniformity in rules. The fact that every society and company invited to send a delegate has responded favorably promises well for the success of the movement, and while there will be many interests to harmonize and provide for the seemingly difficult task of satisfying everybody may not be of such magnitude as appears on the surface. Earnest and sincere work in this direction will accomplish what is needed. The importance of the subject will insure the most careful consideration of those having in charge the delicate and difficult work.

CONCERNING X-RAYS.

It is stated that Mr. Edison thinks the X-rays will kill bacteria. This is a valuable point for experimenters to work on.

A dispatch from Berlin on February 23 states that in consequence of experiments with the Röntgen rays enabling the reading of the contents of enclosed letters, a Berlin chemist is making experiments with a substance for the manufacture of envelopes which will be impervious to the rays.

Dr. M. I. Pupin thinks that there is a possibility of being able, with the aid of X-rays, to distinguish in a non-homogeneous mass of metal the various constituent metals. The X-rays, he thinks, will be of as great service in metallurgy as in surgery.

The London *Electrical Engineer* says that the word "electrosciography" is to be the name for the process of taking "photographs" on Prof. Röntgen's methods. If our English friends want the word they can have it, without any danger of Americans making any claim upon it for its beauty or applicability. Some of the names proposed on this side of the Atlantic are incomprehensible enough, but "electrosciography" is an abomination.

Prof. Neusser, of Vienna, who has been experimenting with X-rays in diagnosis, showed at his University lectures recently two photographs, one showing gall-stones in the body of a patient, and the other a stone in the bladder. The gall-stone shown was photographed in the liver of a patient. It was altogether opaque to the X-rays, and so appeared snow white on the negative. In the second photograph the stone showed its form clearly enough, but was darker, being more transparent to the X-rays.

MORE ELECTRIC RAILROADS IN NEW YORK.

The electric conduit system on the Lenox avenue branch of the Metropolitan Traction Company, New York, has given such satisfaction in practical operation as to induce the officials of the company to consider the feasibility of introducing the electric system on the Sixth and Eighth avenue branches.

A representative of THE ELECTRICAL AGE called at the company's offices on Tuesday last to ascertain what action had been taken in the matter. He was informed that the subject was now under consideration by the company and that the matter would be definitely settled in a few days. Although it could not be given out officially, the opinion seemed to prevail that there was no doubt about the introduction of electric power on these two important lines.

This great undertaking will involve the expenditure of a vast amount of money and labor. The Sixth avenue line is nearly nine miles long, and the Eighth avenue road has a mileage of twenty miles. Both lines will have to be entirely reconstructed for the electric system.

HYDRAULIC GEARING FOR ELECTRIC CARS*

BY HARRY E. DEY.

Mr. Dey introduced his subject, first by a brief consideration of the principles of hydraulics, and then those governing the action of dynamos and electric motors. In his discussion of the electrical principles he endeavored to show that the shunt motor possessed many advantages for street car service, providing a satisfactory variable speed

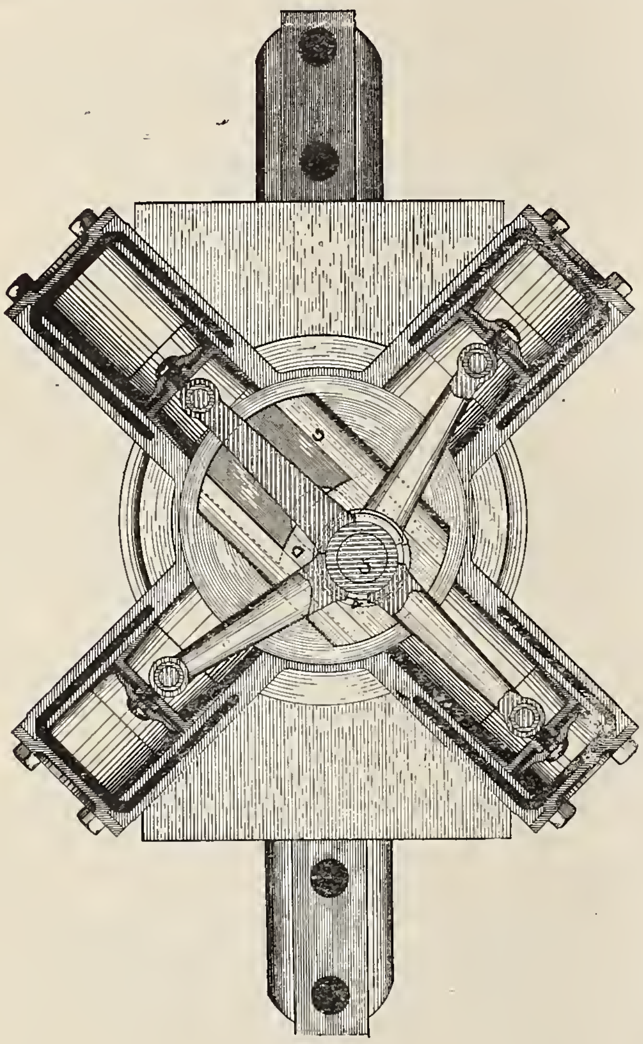


FIG. 2.

gearing were devised. Such a gearing was available in his system.

"Let us look into the hydraulic gear and see what we can accomplish with that," he continued. "In our system of hydraulic gearing we propose to use a pump, or rather two, which are operated by a shunt-wound motor; one is driven by the armature, and the other by the field. We

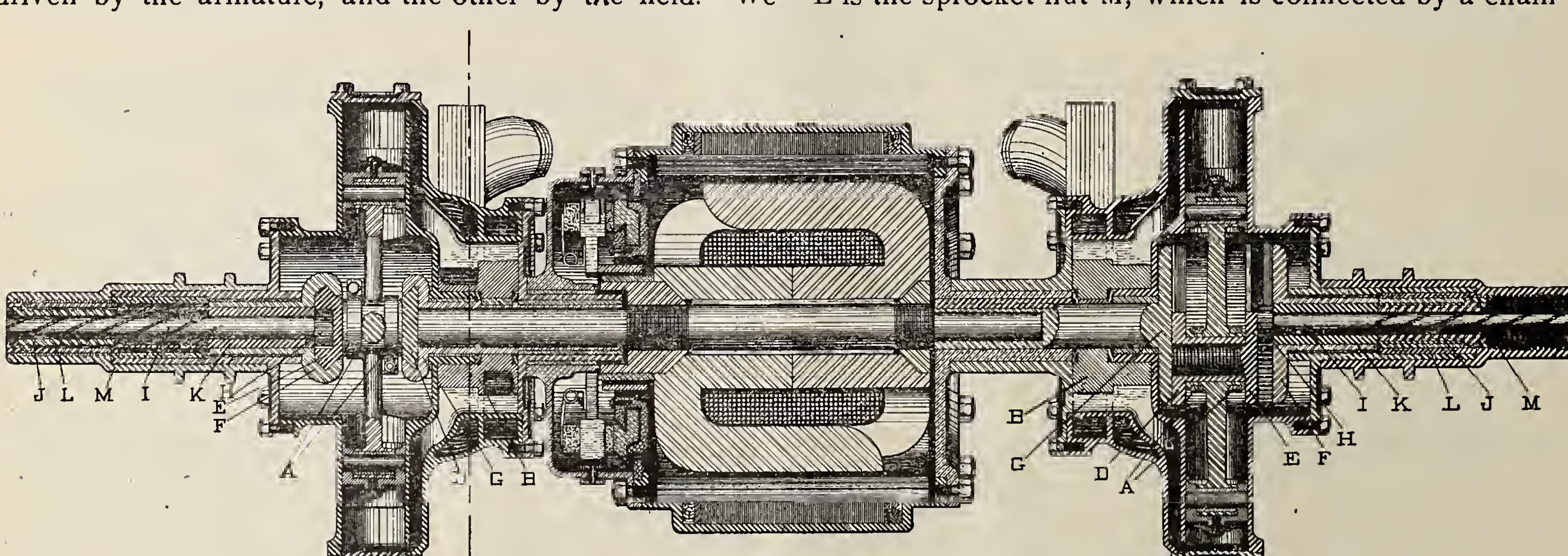


FIG. I.

revolve both field and armature, for, by doing so, we double the counter E. M. F., and hence double the power from a given weight of motor is obtained. The crank pins of these pumps are capable of being adjusted at any point from the centre, where they constitute practically a part of the shaft, to one and one-half inches either side of it. This, of course, varies the stroke anywhere from zero up to three inches, and when the pin is on one side of the centre it drives the oil in one direction, and the reverse when on the other side. These pumps are connected to fluid motors on the axles of the car by flexible pipes, the two fluid motors and pumps being all connected in series and alternating in position. The whole arrangement is filled with oil. The fluid motors are driven at a speed depending on the relative capacities of themselves and the pumps, and as the capacity of the latter depends upon the position of the crank-pin it follows that the pin will entirely govern the speed and direction of the car.

The crank pin and the beveled plates D and E, Fig. 1,

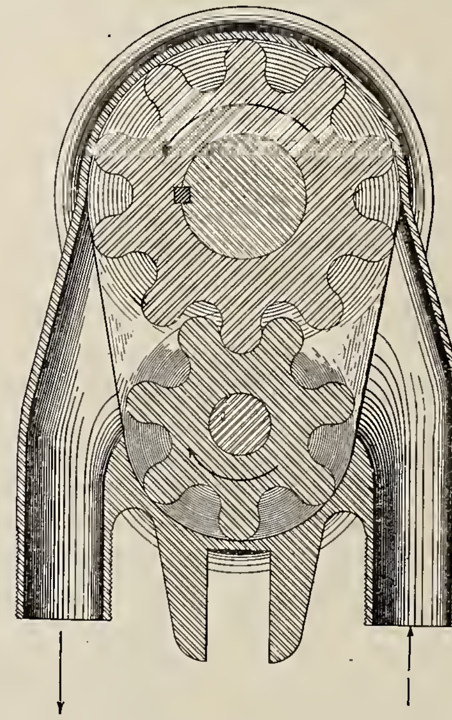


FIG. 3.

form practically one piece. Though made in two parts, one part threads into the other. These plates slide into the dovetailed grooves of plates F and G; plate E has a rack which meshes with the pinion H; the latter is keyed to shaft I, which has four parallel, high-pitch threads cut upon it. The nut J threads on these and also slides in a groove in K, which is an extension of the main shaft, with which all of these parts revolve. L is normally a stationary nut threaded on the outside and having the nut J freely revolving inside of it. These keep their relative positions by means of the collar shown. Working in the thread of L is the sprocket nut M, which is connected by a chain to another sprocket on the controlling wheel shaft. The turning of the controlling wheel turns the nut M, which draws L in or out; this in turn draws K in or out, revolving I and H to move the crank pin. It will be seen that in any position the crank pin is locked. In some cases an electrical device will be used instead of the chain, a very

* Abstract of lecture delivered before the Brooklyn Electrical Society, January 7, 1896.

simple and neat device having been designed for that purpose. The turning of this wheel governs the speed, while swinging it sideways guides the vehicle.

The fluid motor will be readily understood by an inspection of Fig. 3, noting carefully the direction of the arrows.

It is a well-known fact among electricians that from five to eight times the requisite motive power is placed on a car in order to obtain the necessary torque to start, especially on grades and curves, and this has to be largely increased on carriages, because of ruts, muddy roads and heavier grades, for the rated horse-power of a motor is not delivered until it is running at its rated speed. With this system the motor always runs at its rated speed, and delivers its rated power when required, under all circumstances, and the current consumed is in almost exact proportion to the load.

The speed of the carriage will remain absolutely uniform within a few per cent. under all conditions, and constant attention to speed is done away with. With this system, then, the motor need only be built to meet the average load or horse-power; consequently a very light

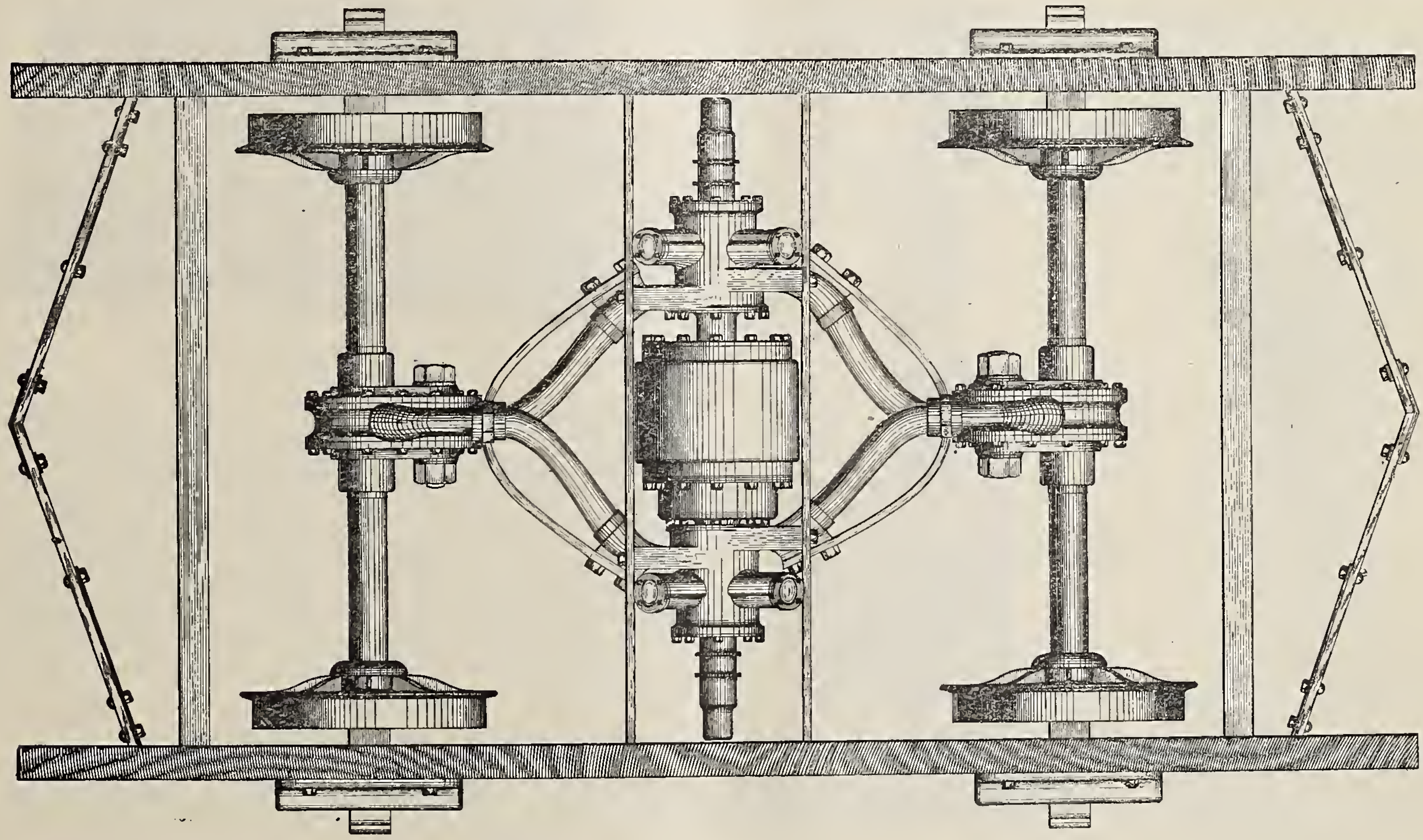


FIG. 4.

motor may be used. Then, again, this is divided by two, from having the armature and field both revolve.

As almost all braking power is transformed as electrical energy back to the battery a very large saving is made in the size, weight and cost of the storage battery, beside a similar saving in the cost of recharging them.

The motori s kept running on ordinary stops of the car, but is consuming very little current, as it is not operating any machinery. In starting a car the crank-pin is moved slightly from the centre; this gives quick-acting but very easy positive start without any jerk. The motion will be very positive but will be held in check, as it were, so that it will not leap ahead only as the pin is moved farther from the centre. The two principles of the hydraulic transmission and the automatic governing of the shunt motor combine to give an ideal start.

We do not propose to use over a twenty-horse power motor as an extreme limit; this motor will only be one-half the size of other motors of the same power, because of the field and armature both revolving. This will do away with about 3,000 pounds of weight. We also dispense with the controllers and rheostat, also the weight of one car wheel, as we can use 24-inch wheels, which will be more satisfactory to the public than the 33-inch ones now in use. We will save, altogether, fully two tons in weight, which is 25 per cent. of the weight of a fully loaded car; this naturally means a similar saving of 25 per cent. in the power required to drive the car. On all down grades the motor will be converted into a dynamo and will return current to the line and, at the same time, act as an ideal brake. All other brakes may be entirely dispensed with. A very conservative estimate will show a saving of at least 50 per cent. in current consumed over any system now in use, when you come to take into consideration the amount saved in weight, and the great efficiency of a shunt motor and the amount of current returned to the line on down grades, and that, perhaps, at points far from the power house, where it will do other cars a far greater amount of good than a similar amount generated at the power house.

The size and cost of the power house feed wires, etc., may be reduced more than one-half, for, besides the savings mentioned, the sudden fluctuations will be done away with.

The lights will be steadier for the same reason; there will be no trouble from frequent blowing of fuses and many other annoyances will be avoided.

Last, but not least, is the field it offers for the alternating current, for it offers the only known solution to the use of the single-phase, alternating, synchronous motor; it will have all the advantages with this machine that it has with the shunt motor. This will open a very wide field for long distance transmission.

The electrical engineer of one of the largest steam roads in the country has examined the system with that object in view, and has expressed himself as tho oughly satisfied that it is practical and the ideal method for the long distance transmission for electric railways.

A special battery will be used called the Dey High Potential Series Storage Battery. This battery has been brought to a high state of perfection and does not conflict with any other patents. Six cells will be used (although less can be). These cells are about 25 per cent. lighter than others of the same horse-power. A carriage complete carrying from two to four people 75 miles on one charge will not weigh more than 900 p unds, and will cost to run seven-eighths of a cent per mile, buying the current at present rates from electric light companies, and about one-tenth of that if a man has his own plant, as many merchants have.

Fig. 2 shows the internal construction of the pump, and Fig. 4 gives a plan of a truck equipped on the Dey system.

DEPARTMENT OF ELEMENTARY EDUCATION.

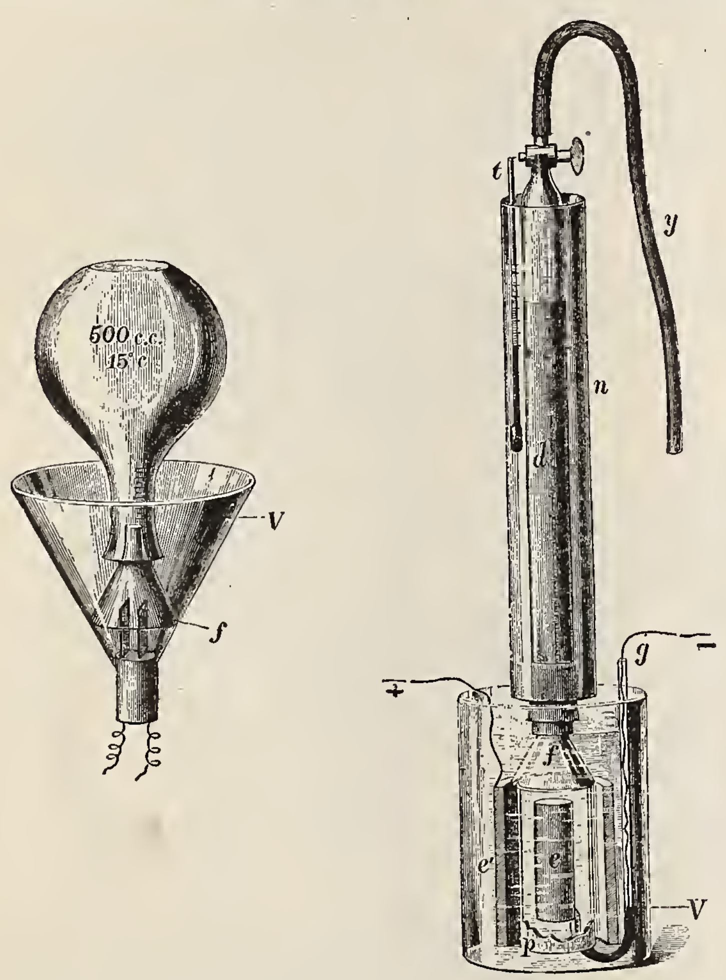
BY THE EDITOR.

[*Note.—Any one is invited to ask questions on any point that is not made clear in these articles. Suitable explanations will be cheerfully given under the head of "Answers to Inquiries."*]

THE MEASUREMENT OF CURRENT.

BY NEWTON HARRISON, E. E.

In order that currents may be measured with accuracy, either for purposes of comparison or direct use, certain

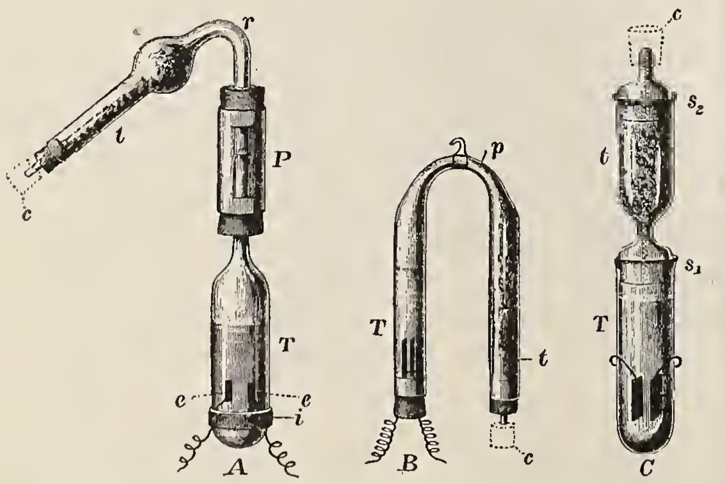


VOLUME VOLTAMETER.

methods must be adopled which may be generally classed under the following headings :

(a) Electro-Chemical, { Volume Voltameter
Metal "
(b) " Thermal
(c) " Magnetic,

The electro-chemical, as defined by its title, is one closely allied to certain chemical reactions produced by

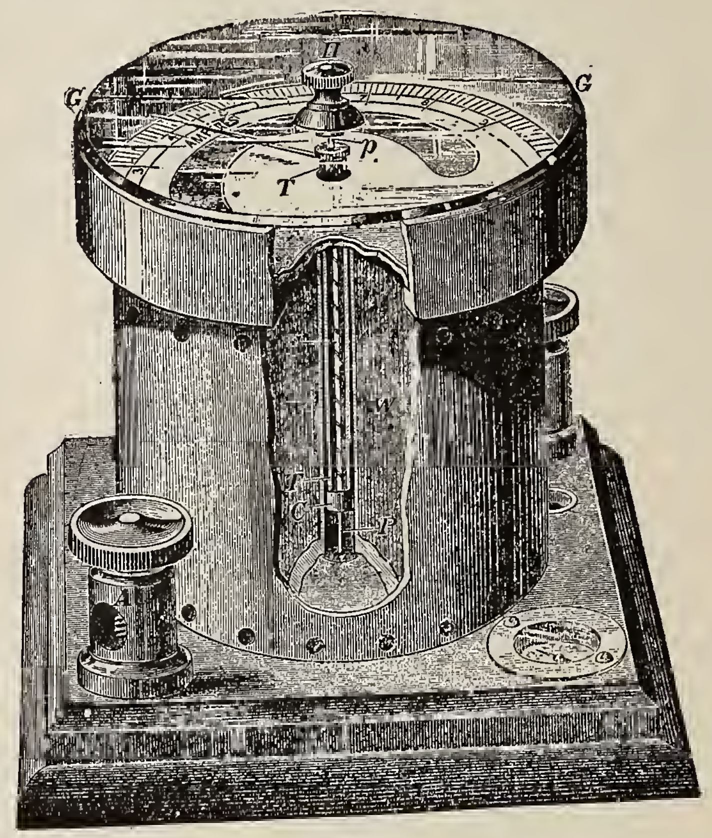


METAL VOLTAMETER.

the passage of a current through a solution. It is therefore possible to review the means by which a current passing through an electrolyte, either of metallic salts or water, produces effects of a reliable and visible nature capable of immediate measurement.

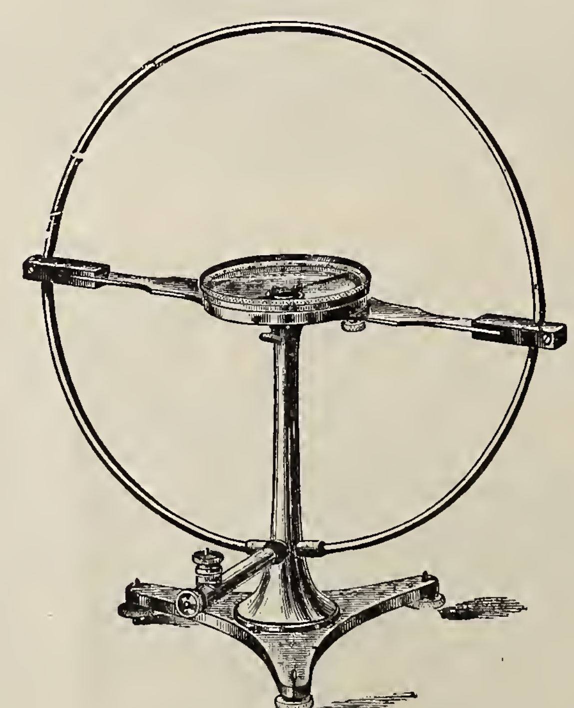
The electro-chemical method calls into use a simple form of instrument called a voltameter.

Voltameters, while serving the same purpose in this case, are divided into two kinds—the *volume voltameter* and the *metal voltameter*.



HOT WIRE AMMETER.

A *volume voltameter* consists of a glass vessel containing a conducting liquid in which is immersed two narrow plates of platinum called electrodes. Upon passing a current through this instrument, the liquid (a weak solution of sulphuric acid), becomes decomposed and a mixed gas is evolved, composed of oxygen and hydrogen. The greater the current applied to the voltameter the more rapidly is the gaseous mixture set free. Each unit of current is capable of producing equal quantities of oxygen and



TANGENT GALVANOMETER.

hydrogen, or equal volumes of gas are produced by equal currents flowing for an equal time. Thus it may be proven that *the strength of the current is proportional to the number of cubic inches of gas developed in one minute.* If, by previous experiments the volume of gas set free from water undergoing electrolysis be ascertained, the strength of current corresponding to a given volume of gas may be used for all future experiments. A volume voltameter may be constructed by means of two copper plates, a glass jar and a deep basin.

The number of cubic inches or cubic centimeters of the jar must be determined. A scale is affixed to the side of the jar denoting this capacity in graduated steps with the zero mark at the bottom of the jar. A wide cork or cover is placed over the jar containing a tube and the two electrodes. If the jar be filled with acidulated water and inverted into the half-filled basin the jar will remain full. But when the two electrodes are attached to a source of current, decomposition ensues and the gas forces the water out.

The number of cubic inches or centimeters of gas remaining between the level of the water and the bottom of the jar can be at once determined.

A *metal voltameter* consists of two electrodes dipping into a solution of metallic salts. If the electrodes or plates are of copper, a solution of copper sulphate will be most satisfactory. Upon passing a current between the two electrodes pure copper is deposited upon the negative electrode. If the negative plate is weighed before and after the experiment, and the time in minutes and seconds carefully noted, the amount of copper deposited each second or minute is quickly determined in grams.

A repetition of this experiment will prove that equal currents always deposit equal weights of the same metal. The current flowing between the plates can be computed by calculating the weight of the metal, in grams, deposited per second.

One ampere deposits 0.32709 milligramme per second; therefore, knowing the weight actually deposited, the true current in amperes is obtained by division.

A coulomb being equal to an ampere flowing for one second, the above method calls for the number of coulombs per second.

Electro-Thermal.—If the extent to which a metallic wire stretches when heated be determined by experiment, the term "co-efficient of expansion" clearly defines such an effect if referred to as the increase in length per foot, or even the percentage of increase over all.

A current passing through a wire heats it, although not in *direct* proportion to the current. If the current is one ampere and the heat be measured, by increasing the current to two amperes the heat becomes four times as great. This is due to the fact that the heat does not depend directly upon the current, but upon $C \times C$, or the square of the current. With a current of three amperes the heat becomes 3×3, or nine times as great, etc.

If a wire carrying a current exercise its expansion or contraction upon a hand or pointer placed before a dial, the wire passing over a little wheel attached to it, and a spiral spring hold the pointer at zero when no current passes, the wire would expand when the current flowed through, the spring would gather in the slack wire, and by doing so move the pointer, thus indicating a current. The elements of an electro-thermal instrument are contained in this illustration.

Prof. Forbes, of England, invented an electro-thermal instrument in which a coil of high-resistance metal being heated by the passage of a current caused a small windmill with mica blades to rotate.

The current would affect the velocity of the prime mover by the least variation, but its extreme delicacy forbade its use as a practical instrument. This instrument might more properly be classed under the head of recording ammeters, as that was its evident object. There are other types of instruments which record both current and pressure, but the principle of their action is not thermal, and they cannot be included here. Hot-wire instruments or their equivalent have fallen into disuse of late, because of the greater accuracy and more attainable perfection of electro-magnetic devices.

Electro-Magnetic.—Electro-magnetic instruments depend for their current-measuring properties upon the relation existing between a current and the magnetic effects that follow from it. Although the methods of measurement employed under this head are very numerous, the means by which effects are produced may be briefly stated:

(1) A coil carrying a current affects a movable magnet.
(2) A magnet affects a movable coil.
(3) A coil affects a movable coil.

Practically all the devices of the above order, with the exception of the last, might be termed galvanometers.

For the absolute measurement of current the galvanometers of the following order come into prominence; they belong to the first order:

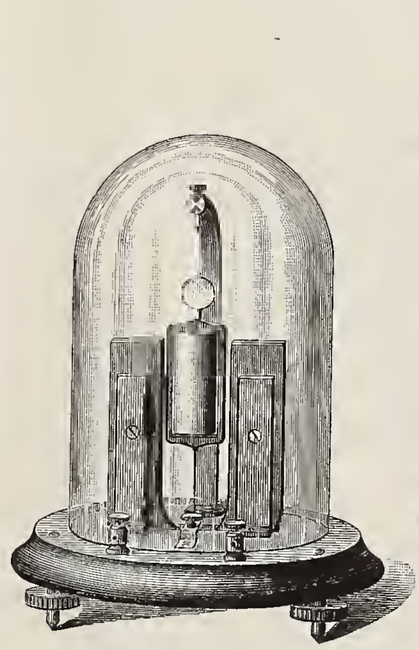
A stationary coil and a movable magnetic needle:
(*a*) Tangent galvanometer.
(*b*) Sine galvanometer.

A most unique type belonging to the second class was invented by M. D'Arsonval, with an immovable magnet and a movable coil. The famous Weston instruments act on the basis of this principle.

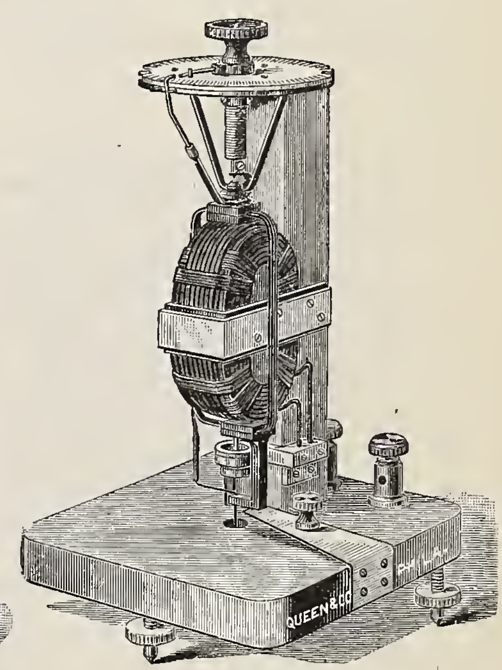
Under the head of the third class—a stationary coil actuating a movable coil—both of the following are practically dynamometers:
(*c*) Dynamometer.
(*d*) Ampere balance.

An intermediate and very common form of current in-indicator consists of a coil whose entire function is the attraction of a soft iron core. As the extent of the attraction depends upon the current, the movement of the core after the proper attachment to a pointer has been made may be marked on a dial and thus used for future reference.

The process of calibration is adopted with such devices, that is to say, the use of currents whose strength is varied and successive values known and recorded on the hitherto



D'ARSONVAL GALVANOMETER.



DYNAMOMETER.

unmarked dial. The Edison Company employed this form of instrument, which is generally known as the Bergmann ammeter.

The *tangent galvanometer* is composed of a coil of large diameter, more aptly designated as a narrow reel. At the centre is a pivoted magnetic needle above a circular dial marked in degrees. The currents passed into the instrument cause different angular deflections. The currents are not proportional to the angles themselves, because by doubling the current the deflection is not increased twice. The currents, however, are proportional to the tangents of the angles. Triple the current will swing the needle around to an angle whose tangent is three times that of the previous angle. A value termed the constant of the galvanometer is found and the current calculated by the rule

$$\text{current} = \text{constant} \times \text{tangent of angle of deflection.}$$

The constant is obtained by sending in a known current —observing the deflection—and its tangent is obtained. The constant which can be used for all future cases is

$$\text{constant} = \frac{\text{current}}{\text{tangent of angle of deflection.}}$$

A *sine galvanometer* works on an equally simple principle, the current being proportional to the sine of the angle of deflection—the rule being

current = constant × sine of angle of deflection;

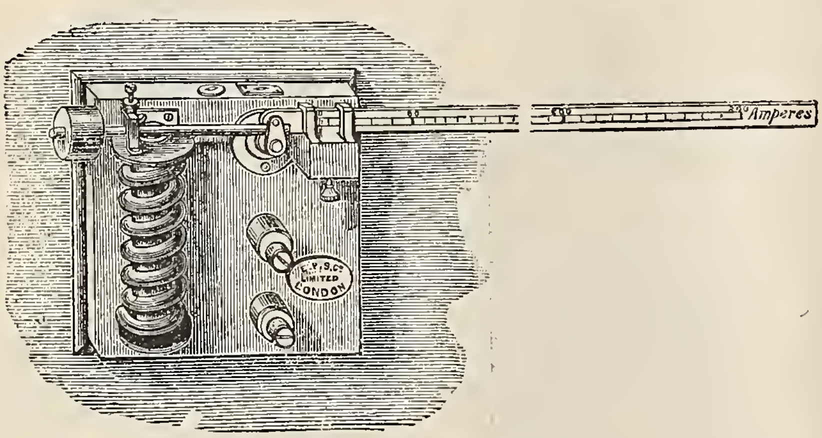
the constant is a quantity determined in a similar manner for practical use.

The D'Arsonval galvanometer has a permanent steel magnet with a coil suspended between its poles. A metal cylinder upon which the wire is wound gives to this instrument the peculiar and useful property of being *dead beat.*

The Weston ampere-meter, or ammeter as it is commonly called, with some slight changes is identical with the above. The coil in this instrument is suspended on pivots. A pair of watch-springs convey current to the coil and bring it back to zero when it ceases.

The springs do not lose their temper, because the entire current passes freely on through the instrument, while a slight portion required for the movement of the coil is shunted into it. The instrument is calibrated by passing known currents into it and the deflections marked on the dial. They are equal, and in ammeters of this particular construction accurate to within $\frac{1}{10}$ of a per cent. The springs unwind as the deflection increases and thus serve in part to equalize the deflections.

Dynamometers record readings which are proportional to the square of the current. A fixed coil is so situated that a coil in the same plane, both being of rectangular shape, is inclined by the effect of the current; the movement of the inner coil acts upon a wire by which it is suspended and also moves the hand of a dial. To bring the coil back to its former position requires a twisting or torsional force, which must be applied to the wire. The current is proportional to the square root of this angle of torsion.



STEEL YARD DYNAMOMETER.

The ampere balance, invented by Sir Wm. Thomson, (Lord Kelvin) depends upon a very simple principle for its action.

A pair of coils are placed side by side and another pair placed above, but balanced like a pair of scale pans on two fulcrums, both being connected rigidly by a bar or pair of bars. The repulsion and attraction are compensated for by weights, which increase the range of the instrument or diminish it. The weights are slid along an arm and thus bring about a balance. The coils are calibrated so as to give a variety of readings, dependent upon the weights, and the extent of correct readings runs into hundreds of amperes. Its great advantage lies in the fact that it can be used equally as well for alternating currents.

Ampere meters are of a variety of shapes as well as kinds, but the majority work on an exceedingly simple principle, as previously described.

Recording ammeters of a somewhat expensive pattern have been produced by various inventors, but today it can hardly be said that there is really a single moderately cheap form of recording ammeter on the market. The Edison Illuminating Co. still adhere to the electro-chemical method in their meters, and the prevalent types of ammeters that are called recording have failed to appeal to them. The hot wire mica-vane instrument of Forbes and possibly a system of photographing a moving spot of light reflected from a mirror, employed by the Walker Co., are the few that utilize complex methods for that purpose.

A famous inventor and scientist suggested the use of a wheel of copper, immersed in a copper sulphate solution, for the purpose just described. The copper wheel being gradually loaded on one side with copper that has been plated on to it would slowly rotate, and thus record the current consumed in the circuit. While the idea is ingenious, the practical development of it is full of difficulties.

A simple form of ammeter of sufficient accuracy to be depended upon, and an equally simple form for the actual recording of the current, would be of value and importance to those practically interested. Were it possible to suppress other phenomena, which invariably make their appearance when a current passes in a circuit, the decomposition of water might be utilized as a possible means by using its accumulated pressure for the movement of a mechanical system, which would record the volume of gas passing.

An ampere has been defined as the current which passes through a resistance of one ohm at a pressure of one volt.

The true unit of current is based upon the absolute system of units sometimes called the C. G. S. system—the centimeter, gramme and second being the quantites involved.

If an arc of wire of one centimeter radius and one centimeter length be brought near a unit magnetic pole, if the unit pole be placed at the centre of a circle of which the wire is a part, it will be affected by the force of one dyne. A dyne is the unit of force developed by the unit of weight moving a unit of distance in a unit of time. As the units have been specified, the movement of one gramme a distance of one centimeter in one second brings into being one dyne.

The arc of wire producing such an effect will then be carrying a unit current. This, however, is so large that the practical unit has been made one-tenth of it, and is called the ampere.

The electro-chemical method of determining the ampere has already been considered. The coulomb comes into direct consideration in this method, it being well known that the transference of a metal never varies in quantity when carried over by one coulomb. Whereas one coulomb of electricity will transfer a different weight of copper than iron, and a different weight of silver than gold, the amount of metal carried over by a coulomb for each particular metal never changes.

Certain fixed proportions always exist, and their immutability has been repeatedly tested without failure.

For Volume Voltameter $C = \dfrac{v}{t \times .1734}$ v = cu. cms. t = seconds.

ELECTRO-CHEMICAL EQUIVALENTS.

	Grammes per Coulomb.
Hydrogen	.00001035
Silver	.00118
Copper	.000326
Water	.00009315

TABLE OF NATURAL SINES AND TANGENTS.

Deg.	Sine	Tangent	Deg.	Sine	Tangent	Deg.	Sine	Tangent
1	·017	·017	31	·515	·601	61	·874	1·80
2	·035	·035	32	·530	·625	62	·883	1·88
3	·052	·052	33	·544	·649	63	·891	1·96
4	·070	·070	34	·559	·674	64	·899	2·05
5	·087	·087	35	·573	·700	65	·906	2·14
6	·104	·105	36	·588	·726	66	·913	2·24
7	·122	·123	37	·602	·753	67	·920	2·35
8	·139	·140	38	·615	·781	68	·927	2·47
9	·156	·158	39	·629	·810	69	·933	2·60
10	·173	·176	40	·643	·839	70	·939	2·75
11	·191	·194	41	·656	·869	71	·945	2·90
12	·208	·212	42	·669	·900	72	·951	3·08
13	·225	·231	43	·682	·932	73	·956	3·27
14	·242	·249	44	·694	·965	74	·961	3·49
15	·259	·268	45	·707	1·000	75	·966	3·73
16	·275	·287	46	·719	1·03	76	·970	4·01
17	·292	·306	47	·731	1·07	77	·974	4·33
18	·309	·325	48	·743	1·11	78	·978	4·70
19	·325	·344	49	·755	1·15	79	·981	5·14
20	·342	·364	50	·766	1·19	80	·985	5·67
21	·358	·384	51	·777	1·23	81	·987	6·31
22	·374	·404	52	·788	1·28	82	·990	7·11
23	·391	·424	53	·798	1·33	83	·992	8·14
24	·407	·445	54	·809	1·37	84	·994	9·51
25	·422	·466	55	·819	1·43	85	·996	11·43
26	·438	·488	56	·829	1·48	86	·997	14·30
27	·454	·509	57	·838	1·54	87	·998	19·08
28	·469	·532	58	·848	1·60	88	·999	28·63
29	·485	·554	59	·857	1·66	89	·999	57·29
30	·500	·577	60	·866	1·73	90	1·000	Infinite

ANSWERS TO INQUIRIES.

[*Note.—This column is open to any of our readers who desire special information on any subject. In case we cannot give the desired information ourselves the inquiry will be published, in order to elicit a reply from some one of our readers. These answers will be published in due course.*

The full names of our correspondents will not be published, but for the purpose of identification their initials or other mark of identity will be substituted therefor.

Each question will be numbered for the purpose of ready reference.

All are invited to make free and liberal use of this column.]

27. In some of the reports about Prof. Röntgen's discovery there are references to X-rays. What is the meaning of X-rays? S. O. I., Waterbury, Conn.

A.—The X means unknown. The rays emanating from the tube that penetrate and pass through opaque substances are new to scicnce, and as little or nothing is known about them they are designed as X-rays, in the same sense that X denotes an unknown quantity in mathematical calculations.

28. Is the vacuum in an incandescent lamp bulb a perfect one? V. N. T., Troy, N. Y.

A.—No; but it is probably as near perfect as can be produced. It is not possible to produce a perfect vacuum. The bulbs of incandescent lamps, however, contain very little air—one millionth or less of the normal volume.

29. I want to place fifty lamps at the end of a double lead, 150 feet long, allowing a five per cent. drop. The resistance of each lamp is 220 ohms. What size wire should I use? W. S. W., Clyde, Ohio.

A.—According to the rule you should use wire with an area of 13,977.9 circular mils—practically No. 8.

30. How can I ascertain the horse-power required for a given number of lamps? L. O., Wellington, Kan.

A.—Multiply together the voltage and ampereage of one lamp, then multiply this product by the number of lamps and divide by 746. The result will be the equivalent horse-power.

31.—(a) Does an alternating current become a direct current after passing through a converter to supply incandescent lamps; (b) will incandescent lamps burn steadily on an alternating current so long as the alternations are more than 33 per second? W. H. H., New York.

A.—(a) No; the current used in lighting the lamps is also alternating; (b) the alternations per second used in electric lighting are not less than 100; fewer alternations would give an unsteady light, although they can be used for power transmission.

32.—Assuming that I desire to install a lighting plant in a town of 2,000 inhabitants, said town requiring 25 street lights 600 feet apart, and 500 store and residence lights, what amount of power and what style and size of dynamo would be desirable, the plant to be 1,800 feet from the centre of town? H. P. P. Houston, Texas.

A.—Assuming you ran two circuits, one for street and the other for store and residence lighting, the machine for the street lights should be of 18 H. P., and that for incandescent lighting of 36 H. P. Your question does not admit of a detailed answer. There are several good makes of dynamos on the market, and we refer you to our advertising columns for the addresses of the manufacturers. The actual conditions in your town might justify the use of the alternating system for incandescent lighting. In our calculations we have assumed that you desire to use the direct system.

IMPROVED CROOKES TUBES.

Mr. Henry Green, president of the Ætna Electrical Co., Hartford, Conn., is reported to have made some great improvements in the manufacture of Crooke's tubes for the production of X-rays. In the improvement Mr. Green has attached to the ordinary Crookes bulb at one end a number of smaller tubes. The bulb is about two inches in diameter and the smaller tubes about one-fourth of an inch.

The aluminum plate is at one end, as in an ordinary Crookes tube, but there is one cathode wire in each of the tubes at the other end. These wires are all connected with the wire which runs to the negative pole of the battery.

Mr. Green in his experiments has used a bulb with seven tubes, and he finds that by increasing the number of tubes he does not diminish the light from each one, so that the more tubes the stronger the light with the same electric current.

In his experiments Mr. Green uses a primary current which may be transformed to a voltage of anywhere from 10,000 to 250,000.

The negatives developed by this process have been excellent. Photographs have been made of keys in a purse and of a number of objects held beneath a thickness of two inches of wood. The objects came out very clearly.

PHOTOGRAPHING THE BRAIN.

The marvellous possibilities in the use of Roentgen's discovery has stimulated intense mental activity throughout the civilized world, and there is no limit to the predictions of what can and will be done by the wonderful X rays. One imaginative contemporary fears that all privacy in human affairs will be gone when the X-ray Kodak fiend is let loose. He will, it is argued, be able to reveal family inner-life, through brick walls, etc., and no one will ever

WHAT IS INSIDE OF SOME HEADS.

know whether his actions are being "shadowed" by a perambulating X-ray Kodak crank or not.

When it comes to photographing the brain, will the subtle workings of that wonderful organ be revealed, too? The artist on the Chicago *Inter-Ocean* has very cleverly expressed, in the accompanying illustration, his idea of what X-rays will do in this direction. Every man with a hobby—and few of them have none—will be shown up in true light; weak spots on the brain will be revealed, and if a man has wheels in his cranium the X-rays will indicate in which direction they revolve!

PROF. TROWBRIDGE ON X-RAYS.

Prof. Trowbridge of Harvard University gave a public lecture on the evening of Febuary 20, on his experiments with the X-rays. The hall in which the lecture was given was crowded, and hundreds sought in vain for admission. Prof. Trowbridge made a few experiments in a darkened room with ordinary Crooke's tubes, and also showed a tube of extraordinary size which he himself had preferred for experimental purposes. Stereopticon illustrations of the results obtained by Prof. Trowbridge in all his experiments were shown. The most satisfactory were those obtained in photographing the foot and hand.

Prof. Trowbridge said he did not see how the process could be of any great practical benefit until some means of producing parallel rays and of preventing the absorption of the rays by the glass in the Crooke's tubes could be discovered. He had been unable to obtain any satisfactory results in photographing through flesh more than an inch thick, and thought that for the present the utility of the rays as an aid to surgery must be confined to operations on the hand and foot.

AUTOMATIC PHOTOGRAPH MACHINE.

The accompanying illustration gives a view of an interesting machine now being placed upon the market. It is an automatic photograph machine, and will make the exposure, develop and deliver the plate in 40 seconds.

The machine is extremely ingenious, both in conception and mechanical construction. The person "sitting" for a picture hands to the attendant a dime, which he drops in the slot, and the machine, with the aid of electricity and mechanical power, does the rest.

After arranging the proper pose, and the coin is dropped into the slot, the duration of the exposure is announced by the ringing of a bell.

At each side of the cabinet is a shutter, which drops after the exposure has been made and uncovers a circular pane of ruby glass through which the person may witness the operation of developing the picture. When the shutter drops it closes an electrical circuit embracing two amber colored lamps. These lamps illuminate the interior of the cabinet so that the operation of development in its first stages can be witnessed through the ruby glass. When the plate has gone into the "fixing" bath two white lights are turned on, giving a stronger illumination. The plate, after passing through the water bath, is lifted out and dropped into a chute through which the picture is delivered.

The automatic operation of developing the plate is deeply interesting. The machine drops the plate into the various baths in succession with wonderful precision, and as one looks upon the moving mechanism and sees what it accomplishes it seems to be almost human.

The interior lamps are connected to any ordinary incandescent circuit by means of a plug, the cutting in and out of circuit of the lamps being accomplished by means of revolving cams. The shutter mechanism is operated by two cells of any dry battery. Arc lamps, one on each side of the cabinet, or daylight, may be used in making the exposures.

The practical operation of the machine was tested a few days ago by a representative of The Electrical Age. He "sat" several times and in each case the machine delivered the picture with remarkable punctuality. The pictures were excellent, and there is no doubt that the machine will take well with the public.

These ingenious machines are made by the Automatic Photograph Machine Co., cor. Pearl and New Chambers streets, New York. The company is very busy turning them out to meet the large demand that has already sprung up for them.

Mr. R. Lo Forte is vice-president and general manager of the company.

The pictures are about 2x2½ inches in size and of the regular tin-type style. Each one is placed in a neat case by the attendant before it is delivered to the purchaser.

COMPARATIVE COST OF GAS AND ELECTRIC LIGHT.

Taking gas and incandescent lamps at equal candlepower the equivalent rates would be as follows :

Gas at $1.00 per thous. equals	16 C.P. lamps at	½c. per hr.
" 1.50 " "	16 " "	¾c. "
" 2.00 " "	16 " "	1c. "

STANDARDIZING WIRING RULES.

New York, February 20, 1896.

Editor of The Electrical Age:

Dear Sir:—On behalf of the Committee on Standard Rules for electrical construction and operation of the National Electric Light Association, I take pleasure in sending you herewith a statement as to the present condition of the work undertaken by that committee for the forming of a joint committee, composed of the various electrical, insurance and allied interests, which joint committee it is proposed shall take up the most important matter of the codification, promulgation and enforcement of one standard set of rules which shall meet as fully as possible the conditions that now exist, be up to date, and prove acceptable to the various interests affected by electrical construction work.

The following organizations were invited to co-operate, and our committee is most pleased to state that in every instance the invitation extended has been accepted, and in the appended list is given the names of the delegates appointed to represent these various organizations; and the character of the appointments made is in every case so high as to guarantee a most careful consideration of the important questions to come up and their treatment in an able and conservative manner. The list of those who have been invited to co-operate with our committee, together with their delegates, is as follows :

American Institute of Electrical Engineers, Prof. Francis B. Crocker, Columbia College, New York.

American Street Railway Association, John A. Seely, Consulting Electrical Engineer.

National Board of Fire Underwriters, William H. Merrill, chief electrician, Chicago, Ill.

Western Union Telegraph Company, A. S. Brown, chief electrician, New York.

Postal Telegraph Company, Francis W. Jones, chief electrician, New York.

American Institute of Architects, Alfred Stone, secretary, Providence, R. I.

National Association of Fire Engineers, Capt. William Brophy, electrical expert of the commissioners of wires department, City of Boston, Mass.

American Bell Telephone Company, C. J. H. Woodbury, of the engineering staff, Boston, Mass.

General Electric Company, Lieut. S. D. Greene, General Manager Lighting Department, New York.

Westinghouse Electric & Manufacturing Company, Charles F. Scott, electrician, Pittsburgh, Pa.

The committee of the National Electric Light Association who have had charge of the standard rules of that association for a number of years, and who have taken the initiative in the forming of the joint committee, are as follows :

William J. Hammer, chairman, consulting electrical engineer, New York.

James I. Ayer, consulting electrical engineer, Boston, Mass.

Harrison J Smith, general operating superintendent Edison Electrical Illuminating Co., New York.

E. A. Leslie, vice-president and general manager Manhattan Electric Light Company, New York City.

Capt. William Brophy, electrical expert of the commissioner of wires of the City of Boston, Mass.

In view of the various misconceptions of the Committee of the N. E. L. A. and of the Joint Committee, it will not be out of place to state that the various associations have been invited to send a delegate to the joint conference, on March 18th, but not in any way was it intended to commit them to any definite action at the meeting. It is proposed that the various rules which have been promulgated by the various interests, electrical and insurance, shall be taken up for consideration and thoroughly discussed from the standpoint of the various interests represented at that meeting, with a view of forming a new code comprising the best that is in the various sets of rules now in vogue, and new matter considered advisable; that the delegates should take part in the discussion and vote upon the various matters which would come up bearing upon the importance and value of the rules submitted, and after a code has been prepared which has met with the approval of the various delegates attending the meeting, that the code thus prepared should be submitted by the various delegates to the bodies which they represent with the intention that they shall ultimately, if it is deemed advisable by the various national organizations, be approved by them. And, as stated before, it is not the intention that the questions taken up in the discussion shall commit the various organizations to any definite decision in this matter at this meeting or thereafter, if they should deem it inadvisable to co-operate.

It seems almost unneccssary to call attention to the paramount importance of securing the adoption of one single standard set of rules. Examine the condition of things which exists today, in which we have the code of rules issued by the National Electric Light Association, which, as is well known, are largely the basis of all the rules used in the United States; the code adopted by the National Board of Fire Underwriters; the rules issued by the various illuminating companies; the rules of the Manufacturers' Mutual, of the New England and similar associations; the rules now about to be issued of the Fire Department of the City of New York, and similar organizations in other cities; the independent sets of rules prepared by consulting engineers, insurance experts, etc., which are more or less in vogue in the United States. Unquestionably, the existence of these various rules, which are all of them of greater or less intrinsic value and importance, lead to a tremendous amount of confusion, misunderstanding, expense, litigation and, I think, will be generally admitted, frequently to the interpretation and enforcement of the various rules largely in accordance with the personal views of the local inspectors. By securing the adoption, promulgation and enforcement of one single standard which will meet with the approval of the various electrical, insurance and allied interests, and which rules shall be the result of the joint action of these various interests and not be fathered by any particular association, electrical, insurance or otherwise, we shall arrive at a condition of things which has been hoped for and worked for for many years past. It seems, then, as the preliminaries for the proposed joint meeting have been so successfully inaugurated, that it is the duty of not only the various organizations which are co-operating at this joint meeting, but electrical and insurance men, and those connected with allied interests, should lend every assistance and encouragement in their power to secure the aimed-at and much-to-be desired result of the adoption of a single National Code of Rules.

On behalf of the preliminary Committee of the N. E. L. A., who are arranging the details of the meeting which is to be held on the 18th of March (and probably on the 19th as well), I wish to extend an invitation to anyone to send either to my address or to Mr. George F. Porter, Secretary of the National Electric Light Association, 136 Liberty street, any criticism or suggestion upon any of the rules now in vogue or matter which might be included in the proposed new code.

In conclusion, I take pleasure in stating that the American Society of Mechanical Engineers have extended the courtesy of the use of their headquarters at No. 12 West 31st street, for the holding of the proposed joint meeting, on March 18 and 19, 1896.

Respectfully submitted,
William J. Hammer,
Chairman Committee N. E. L. A.,
1305 Havemeyer Building,
26 Cortlandt street, New York.

ELECTRIC PLOW.

It is not general known that one of the first practical applications of the electric transmission of energy was for the operation of a plow, driven electrically by an electric current generated at some distance, and transmitted to the electric motor by suitable conductors.

NEW BOOKS.

Electricity up to Date—for Light, Power and Traction. By John B. Verity. 238 pages; illustrated. Frederick Warne & Co., New York. Price, $1.00.

The author has endeavored to chronicle the advances in electrical development in every useful branch and bring his subject up to date. The scope of the book will be better understood by giving the titles of various chapters: The dynamo and how it is driven; electric lighting by arc lamps; electric lighting by incandescent lamp; the storage of electricity; wiring of a house; transmission of power by electricity; electric traction; electro-therapeutics; electric cooking and heating. The book contains much other information of a general character, and no doubt it will meet the demand for "something up to date." The work is gotten up in the usual, first-class style of the Warne establishment.

Alden's Living Topics Cyclopedia is the title of a new work published by John B. Alden, of New York. It is a record of recent events and of the world's progress in all departments of knowledge. The first volume, just issued, runs into the B's. It gives a great deal of valuable and timely matter for the busy man, and is probably the first book to describe the newly discovered element Argon. The subjects are condensed to as small compass as possible, all of the main facts being preserved, however.

This work is of convenient size, and there is nothing as acceptable to the business man who is in search of live facts.

The first volume, which of course is the prototype of the series, is neatly bound and well printed.

The price per copy is 50 cents.

PERSONAL.

Mr. F. A. Williams, superintendent of construction for the Safety Insulated Wire and Cable Co., New York, has just returned from Boston, where he has been engaged for several months past superintending the work connected with the large installation of safety underground cables in that city. Mr. Williams has been engaged on this work since the first of last October and employed a large force of men in the laying of the cables. The cables laid down vary in size from 200 conductors of No. 19 B. & S. gauge down to four conductors, and in length from 800 feet to 890 feet. They were for the Western Union Telegraph Co., the Police Department, Holmes Electric Protective Co., the Boston Electric Protective Association, the Boston Automatic Fire Alarm Co., the United Telegraph Co., the Boston Auxiliary Fire Alarm Co., and underground cables for the town of Brookline. They are working well and giving perfect satisfaction. This was one of the most difficult installations ever undertaken, on account of the great variety of conductors in the cables.

THE NEW YORK ELECTRICAL SOCIETY.

The New York Electrical Society was organized in 1881, "for the advancement of electrical knowledge and the study of electrical and other scientific phenomena."

In carrying out this purpose, the endeavor of the officers of the society has been to make it a help and stimulus to young electricians, and an up-to-date means for the general public of discussing and illustrating the most recent and interesting developments in electrical work.

In the past many interesting lectures have been delivered, and among those yet to be given during the present season are the following:

"Meeting at the Duane Street Edison Station;" paper on Central Station Work, by the president. (This meeting was held on Thursday night of the present week.)

"Storage Battery Traction," by George Herbert Condict. Illustrated by the actual running of storage battery cars.

"The Chemistry of Cable Manufacture," by W. M. Habirshaw.

"The New Underwriter Rules and their Bearing on the Electrical Arts," by E. H. Johnson.

"Street Railway Practice in the United States," by the Editor of the Street Railway Journal.

"A Night with the Thermopile," by H. Barringer Cox.

Other lectures and papers are also under contemplation.

Any person of good repute who is connected with or interested in electrical work is eligible for admission to the Society. An application blank, which will be forwarded by the secretary on request, must be filled in with the name, address and occupation of the applicant, and returned. The name will be indorsed by a member and duly presented for election. The entrance fee is $1, and the yearly dues are $3.00.

THE CUTTER COMPANY'S GOOD FORTUNE.

The Cutter Electrical and Manufacturing Co., 1112 Sansom street, Philadelphia, announces that the assignment made in August last has been dissolved and, with largely increased capital, it will continue its business as heretofore.

The company will devote special attention to the manufacture of its C. S. flush switches and the I. T. E. automatic magnetic circuit breakers. The demand for "circuit breakers" is already taxing the present capacity of its factory.

The same careful attention to detail will insure a high standard of excellence in the several articles produced.

THE UNITED STATES TELEPHONE CONSTRUCTION CO.

The United States Telephone Construction Co., of Philadelphia, have moved their offices from the Bullitt Building to very handsome quarters in The Philadelphia Bourse.

They have also largely increased their capital and are going into the telephone business on a much larger scale than heretofore, their plan being to organize state or sub-companies to cover the entire United States, and allow these companies to manufacture their own instruments when desired, thus giving each sub-company all the manufacturing profit and an opportunity to meet all local requirements.

If the Berliner patent is sustained by the United States Supreme Court, this company, owning and controlling the *Method Patent* for a Make and Break Telephone, they claim will be practically the only opposition the Bell Company will have.

They will make five styles of telephones and guarantee each and every one of them to be absolutely non-infringing in every particular.

Their new long-distance 'phone is guaranteed to talk over 5,000 miles of resistance, and is said to be superior to any telephone on the market.

FINANCIAL.

The Edison Electric Illuminating Co., of New York, reports gross earnings for January of $218,181, an increase of $12,539 as compared with the same month of last year, and net $116,855, an increase of $12,537.

REUTE INTERIOR CONDUITS.

The Reute Conduit Company, which was recently organized for the manufacture of interior conduits, has been absorbed by the Interior Conduit and Insulation Company. Both Messrs. Reute and Greenfield will hereafter be identified with the Interior Conduit and Insulation Company.

Telephone Notes.

Allison, Ia.—Arrangements are being made for a telephone line between Allison and Grundy Centre, via Parkersburg.

Grafton, N. D.—Grafton and Grand Forks will be connected by telephone in the spring.

Albuquerque, N. H.—The Colorado Telephone Co., is making arrangements to connect this city with a number of neighboring towns in this county.

Athens, Tenn.—T. J. Long intends to organize a company to construct a telephone system.

Newport, Ky.—A telephone system will be equipped by W. O. Rhodes and P. E. Blow, of Knoxville, Tenn.

Corpus Christi, Texas.—The lines of the Alice, Wade City and Corpus Christi Telephone Co. will be extended from Pettus City to San Antonio.

Laurel, Ill.—Laurel expects to soon have a telephone line connecting the town with several places in Maryland.

TELEPHONE PATENTS ISSUED FEBRUARY 18, 1896.

Telephony. Frank R. Colvin, New York, N. Y. (No. 554,656.)

Telephone. William H. Russell, New York, and George E. Russell, Little Falls, N. Y. (No. 554,895.)

Telephone-Instrument. Harry P. Pratt and Henry A. Allen, Chicago, Ill. (No. 555,051.)

FOR UPTOWN TELEPHONE SUBSCRIBERS.

An uptown branch of the Contract Department of the Metropolitan Telephone and Telegraph Company has been established at 113 West 38th street (one door from Broadway), where all business relating to the supply of telephone service can be transacted as readily as at the main office at 18 Cortlandt street. There are 14,000 telephone stations in New York City. Metallic Circuit Service, Rapid, Efficient Permanent, can be had from $75 a year.

New Corporations.

Ilion, N. Y.—Ilion Street Railway Co. Capital stock, $10,000, and the directors are Seth G. Heacock, Floyd S. Brooks, D. E. Walker, Lizzie G. Walker, Wm. Heacock, and others.

Bridgeton, N. J.—Bridgeton Electric Co. has been incorporated by John Riley, Schenectady, N. Y.; Henry M. Francis, Brooklyn, N. Y.; Wm. A. Logue, Bridgeton; Edwin D. Mullen, Philadelphia. Capital stock, $25,000.

Denver, Col.—The South Platte Railroad and Power Co., incorporated by S. T. Smith, J. E Rockwell, Norman Allen, Geo. F. Dayton and J. H. Dayton, to construct a new electric road from Denver to Cripple Creek. Capital stock, $1,000,000.

Albany, N. Y.—The Patchogue and Port Jefferson Railroad Co. has been incorporated by Joseph B. Swezey, Edwin Bailey, James R. Skinner and others, to operate a street surface railway 14 miles long, between Patchogue and Port Jefferson, in Suffolk County. Capital stock, $400,000.

Fredericksburg, Tex.—Fredericksburg Electric Light Co. has been incorporated by Chas. H. Wintstz, Jr., Ad Gold, Franz Stein, Alfred Vanderstucken. Capital stock, $7,000.

Milwaukee, Wis.—Milwaukee Electric Railway and Lighting Co. has been incorporated by Wm. N. Cromwell, Arnold Marcus, Charles W. Wetmore, New York; Henry C. Payne, Charles F. Pfister, Frank G. Bigelow, Benjamin K. Miller, Jr., Milwaukee. Capital stock, $8,000,000.

Aspinwall, Pa.—Aspinwall Electric Light Co., incorporated. Capital, $5,000. Directors, E. J. Heinz, A. P. Kirtland, Thomas D. Kirtland, Pittsburgh; George L. Walter, Sharpsburg, and L. H. Smith, Allegheny.

Portsmouth, Va.—The Portsmouth and Pinners Point Electric Railway and Hotel Co. will be incorporated according to a bill passed by the legislature.

Rockford, Ill.—Rockford General Electric Co. Capital, $50,000. Nerwyn C. Wheaton, Jesse Scribner and Godfrey H. Atkins.

Possible Contracts.

Vineyard Haven, Mass.—The Vineyard Haven and Cottage Street Railway Co., of which Josiah Quincy, of Boston is president, has been granted a franchise for its proposed electric road.

Pittsburgh, Pa.—The German Savings and Deposit Bank will erect a new $100,000 building which will require electric lighting.

Skowhegan, Me.—The Somerset Traction Co. will build a branch of the electric road commencing at Cold Brook and running directly north to East Madison, a distance of five miles. This will make about 18 miles of road.

Brooklyn, N. Y.—The Brooklyn Heights Railroad Co. proposes, if possible, to change the motive power on the Montague street railroad, which runs from Court street to Wall street ferry, from cable to electricity.

Flora Dale, Pa.—The Susquehanna Fertilizer Co., of Flora Dale, would like some information on the subject of private plant for generating electricity outside of power; what power would be necessary to light dwelling-house and stable, the cost, necessary building, etc.

Mansfield, O.—The Council is agitating the question of a municipal lighting plant.

Pittsburgh, Pa.—Mrs. Lucy Carnegie took out a peimit for an additional story to the Carnegie Building on Fifth avenue, to cost $15,000. It is to be made of steel and terra cotta.

Long Branch, N. J.—The First Precinct Hotel will be torn down and a new brick hotel, with all modern improvements, costing $15,000, erected in its place.

Oswego, N. Y.—The Oswego Street Railway Co. has purchased the site of the old Shenandoah mill and will soon erect thereon a power house.

Brooklyn, N. Y.—Extensive improvements along the river front are contemplated by the Brooklyn Wharf and Warehouse Co. An electric railroad will be built for the better handling of goods and it will be so constructed that each dock can be communicated with rapidly.

Ellenville, N. Y.—The Ellenville Savings Bank has purchased the Hartshorn Block in that village, and will erect a handsome three-story building on the site.

Asbury Park, N. J—Dr. Bruce S. Keator has leased the property of S. B. Guerin on Mattison avenue, and two additional stores will be built, making a continuous block of eleven stores.

Ballston Spa, N. Y.—The Highway Commissioners of Milton met at the Town Clerk's office to hear the request of Arthur B. Paine, of Philadelphia, for a franchise to build an electric railroad from Ballston Spa to Rock City Falls. The proposed road is to run from the Delaware and Hudson station to Rock City Falls. The Board granted Mr. Paine a franchise. The road is to be known as the Ballston Spa Terminal Railway Co., and work will be commenced on it within a month.

New York City.—Architects Clinton & Russell, 32 Nassau street, acting for the estate of Samuel L. Mitchell, filed plans with the Department of Buildings for the erection of an eighteen-story brick office building at 32 to 36½ Broadway. The cost of the construction is estimated by the architects at $600,000.

Knoxville, Tenn.—An electric light and power plant will be erected by the West End Street Railway Co.

Bridgewater, Va.—Dynamos, motors, etc, are wanted by the Bridgewater Roller Mills Co.

Sioux City, Ia.—In view of several street railway extensions contemplated, across the river and also in this city, the Sioux City Traction Co. is preparing to almost double the present capacity of its plant at the corner of Second and Water streets. In addition to the improvements the entire rolling stock will be remodelled.

Elyria, O.—H. H. Clough, A. L. Garford, William G. Sharp and E. K. Mussey were granted a franchise by the County Commissioners to build an electric line from Oberlin to Wellington. This will connect with the road from Elyria and Lorain at Oberlin. It is expected that the entire system will be built within the next 12 months.

Richfield Springs, N. Y.—The Otsego glove factory and the electric light and power plant at Richfield Springs burned. Loss, $20,000, with no insurance.

Philadelphia, Pa.—Council's Committee on City Property agreed to report favorably an ordinance granting permission to the United Singers of Philadelphia to erect an auditorium, to seat 20,000 persons, on Fotterall Square, for the accommodation of the National Saengerfest to be held in Philadelphia in the summer of 1897.

New York City.—Helena Gelender Asinari, 150 West 59th street, will erect a sixteen-story and tower brick office building at the northwest corner of Wall and Nassau streets.

Mt. Clemens, Mich.—The Mt. Clemens Electric Light Co. has received permission to increase its capital stock to $60,000.

Lexington, Ky.—Sealed bids will be received March 18 for lighting the city of Lexington with gas, incandescent light or electric arc light, as specified by specifications that will be mailed on application. Also bids will be received for the building of a municipal electric arc plant for the city of Lexington, according to specifications that will be mailed upon application. J. B. Simrall Mayor of Lexington, Ky.

Cleveland, O.—A project is on foot to connect Mansfield and Cleveland with an electric railway. At a recent meeting of Mansfield men and Z. S. Stocking, of Cleveland, the Mansfield, Sullivan and Wellington Railroad Co. was organized. The proposition at present is to construct a passenger, mail and freight line from Mansfield northeast, through the villages of Ruggles and Sullivan, thence east to the villages of Penfield and Belden and north to Grafton or Wellington. The company is incorporated with a capital of $100,000

Trade Notes.

In the office of Mr. Charles D. Doubleday, 27 Thames street, New York, can be seen a reinforced cross-arm pin for all electrical construction work, which is said to be the only reinforced oak pin on the market. A ½-inch steel bar runs through its entire length. The bar is specially treated with a non-corrosive paint, which renders the pin indestructible.

The watchman's clock system of C. D. Bernsee, Vanderbilt Building, New York, is used in the Metropolitan Realty Building, on Rose and William streets. We gave an illustration of this building in our issue of February 8.

ELECTRICAL and STREET RAILWAY PATENTS

Issued February 18, 1896.

554,656. Telephony. Frank R. Colvin, New York, N.Y., assignor to the Interior Telephone Company, same place. Filed Nov. 24, 1894.

554,664. Means for Supporting and Insulating Electric Conductors. Thomas T. Eckert, New York, N. Y. Filed Dec. 8, 1894.

554,665. Gas-Lighting Safety Appliance. Frank Engelhard and Frederick H. Engelhard, Springfield, Mass. Filed June 3, 1895.

554,670. Induction-Machine. Walter K. Freeman, Fort Wayne, Ind. Filed July 5, 1895.

554,694. Trolley Support. Frank E. Homer, Cleveland, Ohio. Filed Nov. 30, 1894.

554,697. Lighting Cars. William F. Hutchinson, New York, N. Y. Filed April 15, 1895.

554,716. Electrical Connecting-Cord. Chas. H. McEvoy, Lowell, Mass. Filed May 15, 1895.

554,718. Process of Producing Lakes or Coloring Compounds by Electrolysis. Ralph McKenzie, Jersey City. N. J. Filed Feb. 21, 1895.

554,719. Conduit Electric Railway. Wilhelm Oesterlein, Cincinnati, Ohio. Filed Sept. 21, 1894.

554,723. Insulator. Esten Peloubet, Alexander, Ark. Filed Nov. 1, 1895.

554,759. Electric Battery. Charles Willms, Baltimore, Md. Filed May 3, 1893.

554,760. Electric Battery. Charles Willms, Baltimore, Md. Filed Jan. 19, 1894.

554,761. Electric Battery and Method of Sealing Battery-Cells. Charles Willms, Baltimore, Md. Filed July 12, 1894.

554,766. Electric Clutch. Thomas A. Briggs, Niagara, Canada, and William A. Philpott, Jr., Niagara Falls, N. Y. Filed June 25, 1895.

554,818. Electric Door-Operating Apparatus. Oliver H. Hicks, Chicago, Ill. Filed Aug. 24, 1893.

554,819. Electric Door-Operating Apparatus. Oliver H. Hicks and Robertus F. Troy, Chicago, Ill. Filed Aug. 8, 1895.

554,821. Electromagnet. James Houlehan, Chicago, Ill., assignor, by direct and mesne assignments, to the Houlehan Magnetic Separator Company, same place. Filed May 10, 1895.

554,836. Machine for Connecting Electric Conductors. Harlie J. Savory, Somerville, Mass. Filed April 17, 1893.

554,859. Rail-Bond for Electric Railways. Robert C. Brown, Somerville, Mass. Filed March 21, 1894.

554,862. Means for Recording and Reproducing Impulses. William H. Cooley, Brockport, N. Y. Filed April 16, 1889.

554,868. Electrically-Operated Railway-Track Switch. Frank H. Harriman, Hartford, Conn. Filed Dec. 11, 1895.

554,883. Car Fender. William H. Leavitt, Hingham, Mass. Filed Jan 16, 1895.

554,884. Manually-Controlled Electric Block-Signal System. Arthur G. Leonard, New York, N. Y. Filed July 26, 1894.

554,889. Fire-Alarm-Telegraph System. Jacob F. Mehren, Chicago, Ill., assignor to John P. Barrett, same place. Filed April 4, 1894.

554,895. Telephone. William H. Russell, New City, and George E. Russell, Little Falls, N. Y. Filed Aug. 10, 1895.

554,896. Key-Socket for Incandescent Lamps. Benjamin W. Snow, Syracuse, N. Y., assignor to John Whatley, same place. Filed Jan. 2, 1895.

554,910. Electric Heater, Resistance, or Rheostat. Patrick B. Delany, South Orange, N. J. Filed June 7, 1892.

554,918. Electric-Circuit Closer and Breaker. John R. Farmer, St. Louis, Mo., assignor, by direct and mesne assignments, to the Farmer Electric Company, of Missouri. Filed May 25, 1894.

554,926. Actuating Mechanism for Advertising Devices. Manly M. Gillam, New York, N. Y. Filed Oct. 15, 1895.

554,949. Rail-Bond for Electric Railways. Subbo Nikoloff, Worcester, Mass. Filed Jan. 2, 1896.

554,955. Insulator for Electric Wires. Magin Riera, Havana, Cuba. Filed Sept. 5, 1895.

554,962. Electromagnetic Induction System of Propulsion. Alpheus C. Shuttleworth, Philadelphia, Pa., assignor to The Shuttleworth Electric Company of New Jersey. Filed Feb. 7, 1895.

555,051. Telephone-Instrument. Harry P. Pratt and Henry A. Allen, Chicago, Ill. Filed Feb. 19, 1895.

555,056. Galvanic Battery. Eason L. Slocum, Pawtucket, R. I. Filed July 2, 1894.

555,057. Electric-Lighting System. Eason L. Slocum, Pawtucket, R. I. Filed April 3, 1893. Renewed Feb. 13, 1895.

555,058. Galvanic Battery. Eason L. Slocum, Pawtucket, R. I. Filed Mar. 28, 1893.

ELECTRICAL AGE

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NEW YORK, MARCH 7, 1896.

CONTENTS.

MORE ELECTRIC TRACTION IN NEW YORK.

The Metropolitan Traction Co., New York, on February 27, opened the electric system on the Lexington avenue branch. The cars are propelled by electric power from 130th street down to 105th street, and by cable the rest of the way. The 116th street cross-town line will be opened for traffic soon. This branch will also be operated by electricity. Current for this line and the Lexington avenue section is generated in the 146th street power house, where the power for the Lenox avenue line is produced. The electric lines are working with the utmost satisfaction.

MUNICIPAL LIGHTING IN CLEVELAND.

A bill has been prepared for presentation to the Ohio Legislature authorizing the city of Cleveland to erect, maintain and operate electric light plants and works. The bill authorizes the city to expend $1,500,000 for the purpose and to issue bonds for the amount. If the people approve there will be three plants located in different sections of the city.

ARE TELEPHONE COMPANIES COMMON CARRIERS?

An important and interesting case at law is soon to be decided at Norwalk, Ohio, and the result will unquestionably have an important bearing on telephone interests. The Norwalk Telephone Co., of Norwalk, Ohio, last December, made a request on the Central Union Telephone Co. to be permitted to connect its exchange system with that of the local Central Union system. The Norwalk Co. offered to extend to the Central Union Co. the privilege of transacting business over its lines and pay all expenses in effecting the connections. All of the requests were declined by the Central Union Co., so the Norwalk Co. asked the court for a mandamus to compel the Central Union and Ohio Telephone and Telegraph Co. to grant the privileges asked for. The petition is based on the ground that the Central Union Co. is violating the common-carrier law, which applies to telephone companies as well as to other kindred organizations.

X-RAYS.

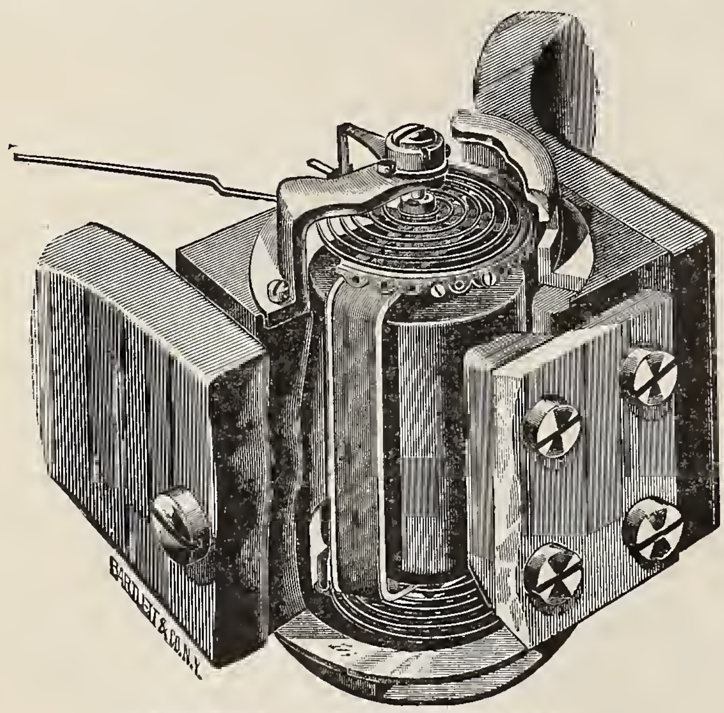
The nature of Röntgen X-rays up to the present time seems to be as mysterious as ever. New facts are being developed by a few of the multitude of experimenters that have a tendency to disorganize the theories that had begun to assume form. Prof. W. C. A. Hammel, of the Maryland State Normal School, has, it is reported, obtained pictures of hidden objects with the aid of an ordinary horse-shoe magnet. He therefore concludes that the unknown ray is magnetic in its nature. His pictures, it is stated, were perfect in outline, light and shade. In a lecture before the Sheffield Scientific School, Yale College, on March 3, Prof. Wright, compared the X-ray with lightning for the reason that the X-ray pictures are similar to those of surrounding objects imprinted by lightning flashes on the bodies of men and beasts struck by it. He expressed the opinion that if Röntgen's assertion proves true, that waves of ether move in longitudinal rays, the discovery will equal in importance that of gravitation. Some interesting X-rays experiments are described in the *American Journal of the Medical Sciences* this month, the object of the same being to ascertain methods and results in the clinical application of Röntgen's discovery. Various pictures are given showing fractured and diseased bones, and the results of the experiments seem to have been quite satisfactory. An endeavor was made to determine whether the X-rays would distinguish between dead and living flesh, but the results were negative. Experiments were also made to determine what effect the rays had upon disease-germs, but cultures of seven different bacteria after exposure for one hour showed undiminished vitality. This result disproves the opinion expressed by Edison a week or more ago that X-rays would kill germs.

THE MEASUREMENT OF PRESSURE.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

The flow of a current of electricity is directly due to the existence of an electric pressure in a wire. Although the evidence of its existence is not such as to give the same impression as would be received by viewing the steam



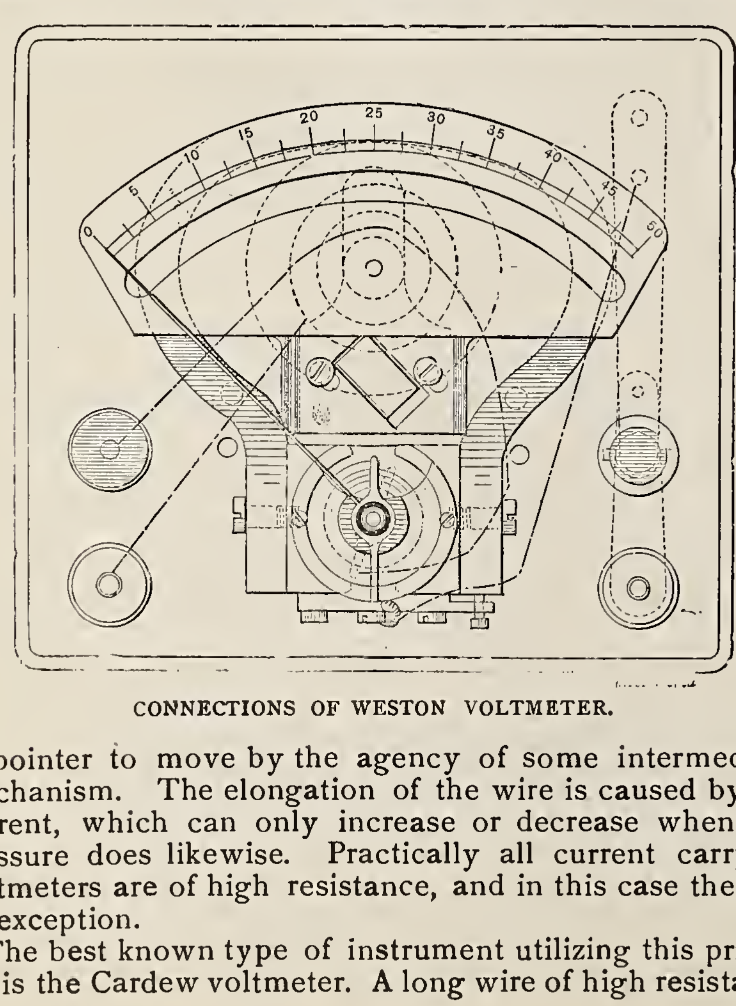
MECHANISM OF WESTON INSTRUMENT.

gauge on a boiler, or the barometer of an air-pump, the reality of its presence soon becomes firmly established in the observant mind.

The forms of apparatus used for the purpose of measureing an electric pressure may be subdivided into three general groups,

Electro-Thermal.
Electro-Static.
Electro-Magnetic.

The *electro-thermal voltmeter* is one in which the expansion and contraction of a metallic body causes a dial



CONNECTIONS OF WESTON VOLTMETER.

or pointer to move by the agency of some intermediate mechanism. The elongation of the wire is caused by the current, which can only increase or decrease when the pressure does likewise. Practically all current carrying voltmeters are of high resistance, and in this case there is no exception.

The best known type of instrument utilizing this principle is the Cardew voltmeter. A long wire of high resistance is strung between two pulleys, a pointer placed in front of a graduated dial is attached to one of them; when the wire stretches, due to the influence of the current, the little pulley over which the wire passes rotates and assumes different positions dependent upon the extent to which the wire has expanded.

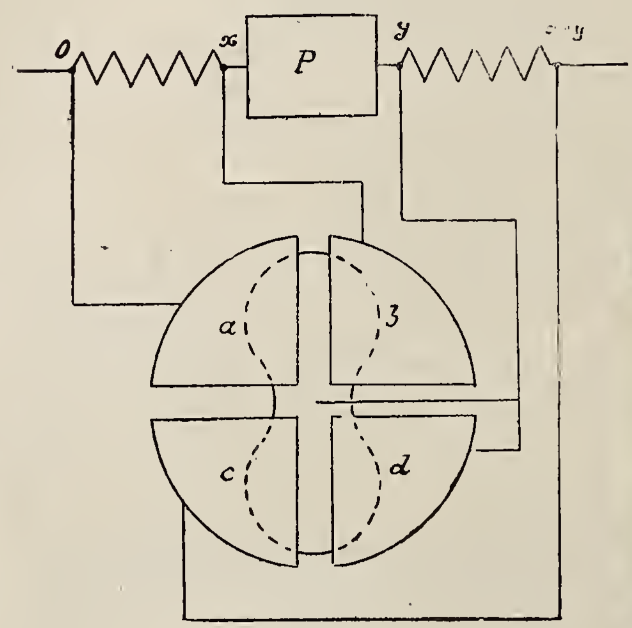
By sending in known currents of increasing strength the positions of the pointer may be permanently marked for future measurements; the voltmeter is then said to be calibrated.

A spiral spring of high resistance material might be used; when the current had caused it to become perceptibly heated the elongation of the spring would become visible by its tendency to untwist. If one end be rigidly held the other could move a pointer, and thus perform the function required of it—the registration of different pressures.

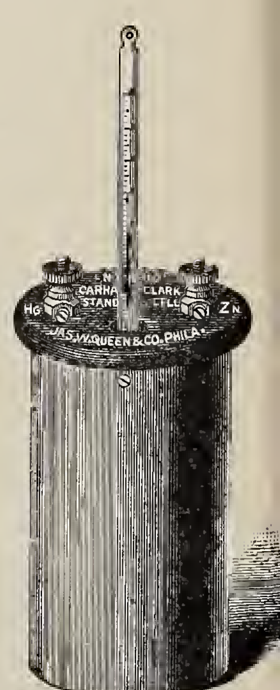
The great object to be held in view in the construction of voltmeters should be their high resistance. The striking difference always noticeable between current and pressure measuring instruments is the very low resistance of one and the extremely high resistance of the other.

Electrostatic instruments that measure volts do so without the consumption of any current.

If any electric circuit be broken and the extremities examined, they will be found individually to possess a positive and negative charge. These terms are merely relative expressions for the potentials existing between two points. An electrostatic instrument therefore simply indicates this condition and measures the difference of potential.



ELECTROMETER.



STANDARD CELL

The electrometer which serves the above purpose acts upon a very simple principle. If two oval-shaped pieces of metal be placed at right angles to each other, one insulated and tightly held and the other suspended above the first by a silken thread, the following will occur:

By charging one positively and the other negatively, the upper one will be attracted out of its position and try to assume a new one directly above the stationary plate. The greater the charge on each, the greater the attraction exerted between them. By attaching a light pointer to the movable plate, or a mirror throwing a beam of light on a scale, the deflection can be accurately observed.

The laboratory instrument is the *quadrant electrometer*, while that employed for practical pressure measurements is the *electrostatic voltmeter*. As both depend upon the same principle, the only difference lies in their respective delicacy of construction.

The *quadrant electrometer* consists of four quadrants lying in one plane and insulated from each other by supports of glass. A metal needle, shaped like two opposite blades of a four-bladed fan, is suspended above by a fine fibre. A mirror attached to the thread and a scale in front for observing the deflection, complete the outfit. Two opposite quadrants and the needle are charged positively and the other two quadrants negatively from the circuit whose pressure is to be measured.

The result is

$$\text{Volts} = \text{constant} \times \text{square root of deflection.}$$

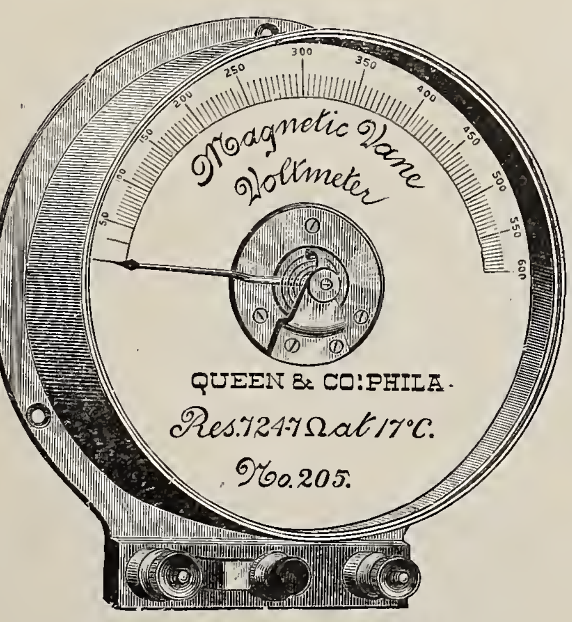
The constant can be found very easily by applying a known number of volts and noting the deflection, because

$$\text{Constant} = \frac{\text{volts}}{\text{square root of deflection,}}$$

thus giving it for future use.

The development of the electrometer into a direct reading voltmeter was effected by Lord Kelvin in an interesting manner.

The electrometer was reduced to two long-shaped plates placed vertically and between them on two light pivots swing the needle with a pointer attached. A small weight holds the needle at zero when readings are about to be taken, but do not prevent the two fixed plates from attracting it out of a perpendicular position where both they and it are oppositely charged. The weight can be changed, and thus increase or decrease the range of the instrument—a heavier weight requiring more difference of potential to move it than a light one. Thus the same scale can be used for hundreds or thousands of volts. The two fixed plates, though in a vertical plane, are inclined in position, the needle being held perpendicularly between them until acted upon by the electrostatic attraction of the two parallel plates.



MAGNETIC VANE VOLTMETER.

A quadrant electrometer can measure a very small difference of potential, a fraction of a volt from $\frac{1}{10}$ to $\frac{1}{50}$ being accurately determined.

An *electrostatic voltmeter* is used for very great pressures, their range including five or six thousand volts. An electrometer possesses the great advantage of being able to measure the pressure of an alternating current, although, to do so, the ordinary connections must be somewhat changed.

The electrostatic voltmeter can be immediately used for this purpose without change, as the reversals of potential do not destroy the attraction existing between plates and needle, whether the needle be positive and the two plates negative, or the needle negative and the two plates positive.

Electro-Magnetic.—A difference of potential can be measured by the electro-magnetic effects produced in a coil of wire, provided the general adjustment of parts be such as to enable the changes that occur to become evident. Those of the last named type have made use of the electrostatic force and do not depend upon a flow of electricity to produce readable effects; in this respect there exists an essential difference between them.

The simplest form of instrument by which an electric pressure can be measured consists of a coil of wire that attracts a soft iron core. The resistance of the coil is very high, being made of fine wire, and an additional resistance sometimes added in the form of a reel of german silver brings the resistance up to a very high point. A dial placed in front of an arm actuated by the moving core can be easily calibrated by the application of a series of known pressures, each being individually marked on the dial as the needle or pointer shifts due to their influence.

A galvanometer can be used for the purpose of measuring great differences of potential by utilizing a shunt in connection with it.

Great use of the standard cell has been made in test work of the finest kind. This is simply a very well made primary cell of constant E M.F. at a certain temperature. The two generally known in laboratory practice are the Clark and Carhart cell. The deflection obtained on a galvanometer with one of these and a fixed resistance and shunt can, by comparison, be made the basis for further calculations with greater pressures under the same conditions.

Weston Voltmeter.—A voltmeter of well-known make is that invented by Edward Weston. It is built upon the principle of the D'Arsonval galvanometer, and for accuracy and reliability stands unequalled. It is inherently a galvanometer, but of so practical a construction that in spite of its delicacy it can suffer rough usage before becoming injured to a percetpible degree.

It is to be remembered that the ordinary type of galvanometer consists of a fixed coil and a movable magnetized needle. In the above instrument, however, these conditions are reversed. Instead of a small magnetic needle subject to the influence of a thousand disturbances, there is a heavy steel horseshoe magnet whose extremities are hollowed out to receive a small coil of fine wire mounted on pivots. Two watch-springs convey the current to the coil, one being connected to each end of it, though insulated from each other. The current after traversing this coil passes through a series of finely wound reels of German silver wire of exceedingly high resistance.

The metallic drum around which the coil rotates prevents any unsettled swing, thus rendering it *dead beat.* The magnet is rigid in this instrument, and the coil swings freely in contradistinction to the last and more familiar style of ordinary galvanometer.

A pressure can be measured by a system of comparison, as follows: A known high resistance is connected between two points, the difference of potential between which is to be measured. A standard cell and galvanometer are then connected to it so that their respective currents tend to flow in opposition. When a point in the high resistance is reached at which no deflection takes place, the pressure from the cell and the difference of potential between the extremities of that portion of the high resistance balance. Supposing the standard cell to be two volts and the resistance creating this equilibrium between its ends twenty ohms, there will then be as many times two volts in the wire as twenty ohms are contained in its entire resistance. Were the entire resistance of the wire one thousand ohms, the difference of potential existing between its ends would be one hundred volts.

Drop of potential is ascertained in a very simple manner worthy of notice.

When a known current is passed through a wire of known resistance, the fall of pressure throughout the wire can be at once calculated by the rule:

Drop of potential = current $\times$ resistance. The pressure at one end of the wire will vary from that of the other end by that difference. In order to make this method of avail, an ammeter must be used and the resistance of the wire carefully determined.

In shop practice, where an ammeter is the only accessible instrument, a definite number of feet of copper wire will use up a pressure that is not great. The resistance of the wire per thousand feet is given in catalogues of wire manufacturers. The current passing through it will complete the data necessary, and the calculation can be made

with 1,000 feet No. 10 wire = 1 ohm,
with 30 amperes flowing.

$$\text{Drop of potential} = 1 \times 30$$
$$= 30 \text{ volts.}$$

Many interesting problems arise from a study of the drop of potential in a wire. The system of subway distribution, the network of circuits to be supplied to a house, are all built upon the basis of a certain estimated drop from point to point. And the illumination within depends entirely upon the care with which such considerations are made.

Thus the methods above outlined contain the essential principles depended upon for any reliable result in the measurement of pressure.

Electromotive force and difference of potential differ in this respect from each other. The inherent cause of electrical phenomena is due to the presence of a current or charge, but an electromotive force has given rise to the current by establishing a difference of potential between two points, thus allowing a flow of electricity to occur when the circuit is completed. In a cell of battery there are electromotive forces at work within the cell creating a difference of potential outside, by whose means a current can flow if permitted.

Thus electromotive force may be looked upon as the prime cause from which follow the subsequent effects of difference of potential and a current of electricity.

The volt is a unit of pressure. It will send a current of one ampere through a resistance of one ohm,

It is defined in other ways by reference to a magnetic system. *The unit of electromotive force is that which is created in a conductor moving through a magnetic field at such a rate as to cut one unit line per second.*

This definition has practically been adopted by all as the basis of the volt. The volt, such as considered in practice as a unit, would be equal to that electromotive force generated within a conductor cutting 100 million lines of force per second.

Some molecular action within a wire sets up a disturbance whose effects are heat, magnetism and electricity, when the agitation becomes extreme, the heat accumulates with too great a rapidity for instant radiation and the phenomenon of light appears in all its gradations. The original cause of such effects is an electromotive force free to display its activity in so striking a manner.

ANSWERS TO INQUIRIES.

[*Note.—This column is open to any of our readers who desire special information on any subject. In case we cannot give the desired information ourselves the inquiry will be published, in order to elicit a reply from some one of our readers. These answers will be published in due course.*

The full names of our correspondents will not be published, but for the purpose of identification their initials or other mark of identity will be substituted therefor.

Each question will be numbered for the purpose of ready reference.

All are invited to make free and liberal use of this column.]

33.—In an article in The Electrical Age of February 8, on the Cost of Electrical Power Stations, by R. C. Carpenter, that gentleman uses the term "boiler horsepower." Will you please explain just exactly what is considered a "boiler horse-power," and how you ascertain the same? H. P. P., Houston, Texas.

A.—The evaporation of 30 pounds of water per hour from feed-water having a temperature of 100° F., into steam having a pressure of 70 pounds per square inch, is equal to one horse power, This is known as the Centennial Exposition standard and other pressures and temperatures can be corrected from it.

34.—How much coal must be consumed under a boiler in order to yield one-horse power for one hour?

H. McK., Rahway, N. J.

A.—It depends upon the engine you use. Small engines require from eight to ten pounds of coal per hour; ordinary condensing engines from three to five pounds, and large condensing engines from 1½ to 2 pounds.

35.—In the arc light is there any difference in temperature between the positive and negative carbons?

L. A. T., Yonkers, N. Y.

A.—Yes; the positive electrode is hotter than the negative when the lamp is burning.

DEPARTMENT OF ELEMENTARY EDUCATION.

BY THE EDITOR.

[*Note.—Any one is invited to ask questions on any point that is not made clear in these articles. Suitable explanations will be cheerfully given under the head of "Answers to Inquiries."*]

TROUBLES IN DYNAMOS AND MOTORS AND THEIR REMEDIES.

In the following series of articles an endeavor will be made to describe the troubles that all dynamos and motors are heir to, and to indicate a course of remedial treatment for the complaints as they arise. The proficient dynamo and motor tender is the one who knows just what to do when anything goes wrong with the machinery under his charge.

The troubles to which dynamos are subject may be classified under five distinct heads, viz.:

1. Sparking at the brushes.
2. Heating of armature, field coils or bearings.
3. Too high or too slow speed.
4. Failure to generate current.
5. Noises.

Motors, too, have their troubles, which are manifested in three ways, namely:

a—by stopping.
b—failure or difficulty to start.
c—running in the wrong direction.

SPARKING AT THE BRUSHES.

This may be caused by some fault in the brushes themselves; by a faulty commutator; by an excessive current in the armature, caused by overload, or by some fault in the armature.

Faults of the brushes are due to the following abnormal conditions:

When they are not set diametrically opposite each other, as they should be.

When they are not set at the neutral point.

When they are not properly trimmed.

When they are not in line.

When they do not make good contact.

Remedies.

1. When the brushes are not set diametrically opposite one another they can be brought into the proper relation with each other, if the machine is running, by bringing the brushes on one side to the point of least sparking, which is done by moving the rocker-arm and then adjusting the brushes on the other side in the same manner and then reclamping. The brushes should, however, be properly set before the machine is put into motion, by some method of measurement, such as the counting of the commutator bars, or by the use of reference marks placed on the commutator.

2. When the brushes are not set at the neutral point move the rocker-arm slowly back and forth until the point of least sparking is found. Be sure that the commutator is clean and that the pressure of the brushes upon the commutator is not excessive.

3. As to improperly trimmed brushes, they should not be found on any machine. The brushes should always be kept properly trimmed and set. If sparking arises from this cause and the dynamo cannot be shut down, turn the brushes back and cut off the loose and ragged ends of the wires and retrim them the first opportunity. If each set contains two or more brushes, one brush may be taken out at a time and replaced by one properly trimmed during the run on any low voltage machine. To retrim a brush first remove all dirt and oil by the use of benzine, soda or potash, then file or grind to a standard jig and reset carefully, before starting up, by counting the commutator bars, or by the aid of some other measurement, as in Case 1.

4. If the brushes are not in line each brush must be adjusted until it bears evenly on a line and is square with a given commutator bar, unless it is purposely "staggered."

5. If the brushes do not make good contact with the commutator all oil, dirt or grit should be carefully cleaned from the commutator to insure contact with the brushes. The tension screws and springs should then be firmly and evenly adjusted until a good, even contact is secured. A very small quantity of mineral oil or vaseline may then be applied to the commutator and wiped off, leaving only a slight trace of the application. This is sufficient lubrication.

Faults in commutators are the result of roughness of surface, grooves and ridges; unsymmetrical surface, that is, not circular; "high" or displaced bars, or by "low" or depressed bars.

Remedies.

6. Rough, grooved and ridged commutators, and those out of round must be ground down with fine *sand*-paper held in a block fitted to the curve of the commutator, and then polished with fine crocus cloth. Emery in any form must never be used on a commutator. If the defects are too deep-seated for this mild form of treatment the commutator must be turned off with a special tool while it is slowly turned on its bearings; or it may be put into a lathe and carefully turned off. By allowing an end motion of the armature of from one-sixteenth to one-eighth of an inch the wear between the commutator and brushes is evenly distributed and the cutting of ridges is thus prevented. It is also a good practice to occasionally shift the brushes slightly sideways, to distribute the wear evenly.

(*To be Continued.*)

C-D ROSETTE.

This new rosette is named C-D from the names of the manufacturers, The Chapin-Douglas Electric Co., 136 Liberty street, New York. In design the joint is covered by the bead on the base which protects the parts in case of moisture. The location of the binding screws for the fuse links has been made to allow as much space as possible in wiring.

The vital part of a rosette is its contact and ease of putting up. The C-D has two yielding arms in the cap

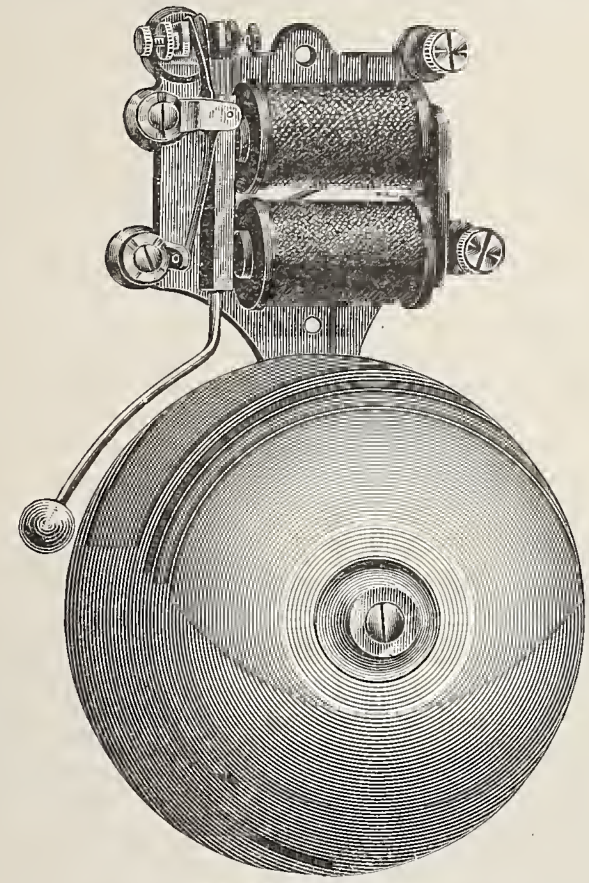
C-D ROSETTE.

marked Y, and the adjustment of this contact in case of wear is simple and easily effected. The contact is made by the yielding arm pressing against the projecting piece in the base under the shoulder S. The cap is held in position by the yielding arm resting under the shoulder "S," and is prevented from passing the projecting piece on the base by a stop-pin on the yielding arm. The caps are interchangeable and can be quickly adjusted to the base, insuring rapid work in wiring.

The C-D rosette is made in the round and square base pattern.

BAXTER ELECTRIC BELL.

In placing the "Baxter" skeleton bell upon the market the object was to meet the demand for a first-class bell at a popular price. The several improvements in the construction of this bell have enabled the manufacturers—H. E. & C. Baxter, Bedford, Division and Canton street, Brooklyn—to accomplish the desired object, and the fact that there is a steadily increasing demand for these bells, is



BAXTER SKELETON BELL.

evidence that their good points are appreciated by those who know a good bell from a poor one.

The frame is well japanned and the parts highly finished in nickel. The various pivots, binding screws, etc., are provided by Baxter's patent fastening, which centralizes them and holds them securely in place.

The bell has both battery and stroke adjustment, provided with set nuts, and by a valuable improvement—the make-and-break contact points are the same for long or short stroke. This allows the armature to feel the full force of the magnets throughout its entire movement.

This bell is rightly entitled to the reputation it enjoys in the trade.

MR. EDISON REPORTS PROGRESS.

Mr. Thos. A. Edison has not yet been able to take the long-looked-for brain photograph. It seems that he cannot get tubes to suit him; no two will act alike as X-ray producers, although they may be precisely alike in every material respect.

Mr. Edison has tried tubes of all shapes and sizes, and is now working with tubes only an inch in diameter, with small tubes at the top and bottom and very small aluminum electrodes.

"We have found," said Mr. Edison, "that it is not the current or the action on the electrodes which controls the power of the rays. They are caused purely by the molecular action on the outside of the glass, producing a terrific bombardment upon molecules in the air."

The inventor says he can take instantaneous photographs with the X-rays by using tubes and photographic plates of his own manufacture. The instantaneous photographs can be taken through cardboard and the plateholder. He has secured a sharp photograph of metal strips through wood four and one-half inches thick and cardboard one-eighth of an inch thick under an exposure of twelve minutes. He believes that he can get a fairly good shadow picture of the brain, or at least of some portion of the skull.

GAS ENGINE ELECTRIC PLANT.

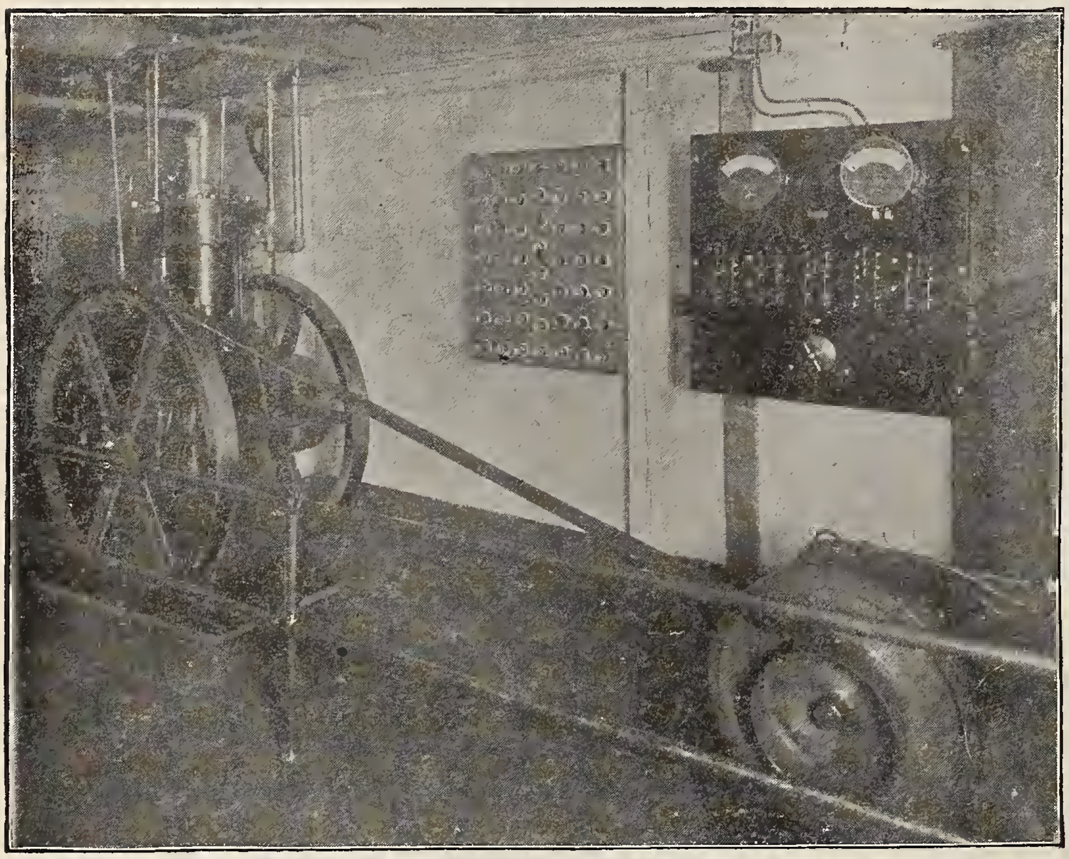
The rapidly extending use of gas engines in this country for the driving of electric generating machinery and the evident favor with which these machines are meeting will add interest to the plant described below.

This installation, which is at the headquarters of the National Meter Company, 298 Broadway, New York, is a model one and is for the purpose of exhibiting the availability and flexibility of the gas engine for operating dynamos.

The plant, of which an illustration is given herewith, is located in the basement. It has a capacity of 50 lights at 120 volts.

On a board near the switchboard the 50 lamps are attached; 10, 15, 25, 35, 40, or all of which may be thrown in and out of circuit by means of switches. On the first or main floor are six Bergmann ornamental incandescent arc lamps which burn two in series with great brilliancy and steadiness.

The gas engine is known as the Nash gas engine, which is the invention of Louis H. Nash and manufactured by the National Meter Company. It is of five actual horse-power and on an actual test varies in speed less than two per cent. between no load and full load. The great feature of the Nash engine is its close regulation and steadiness in running.



GAS ENGINE PLANT OF NATIONAL METER CO.

The switchboard is of dark slate and is equipped with a Weston voltmeter, Weston ammeter and rheostat, and has five double-pole circuit switches for the operation of as many subdivided circuits of the 50 lamps above referred to.

A Riker dynamo is connected with the engine by belt. It generates a current of 25 amperes at 125 volts, running at 1,200 revolutions, and is a very compact machine.

The engine runs at a speed of 300 revolutions a minute, and produces light at about one-half cent per hour per 16-candle-power lamp.

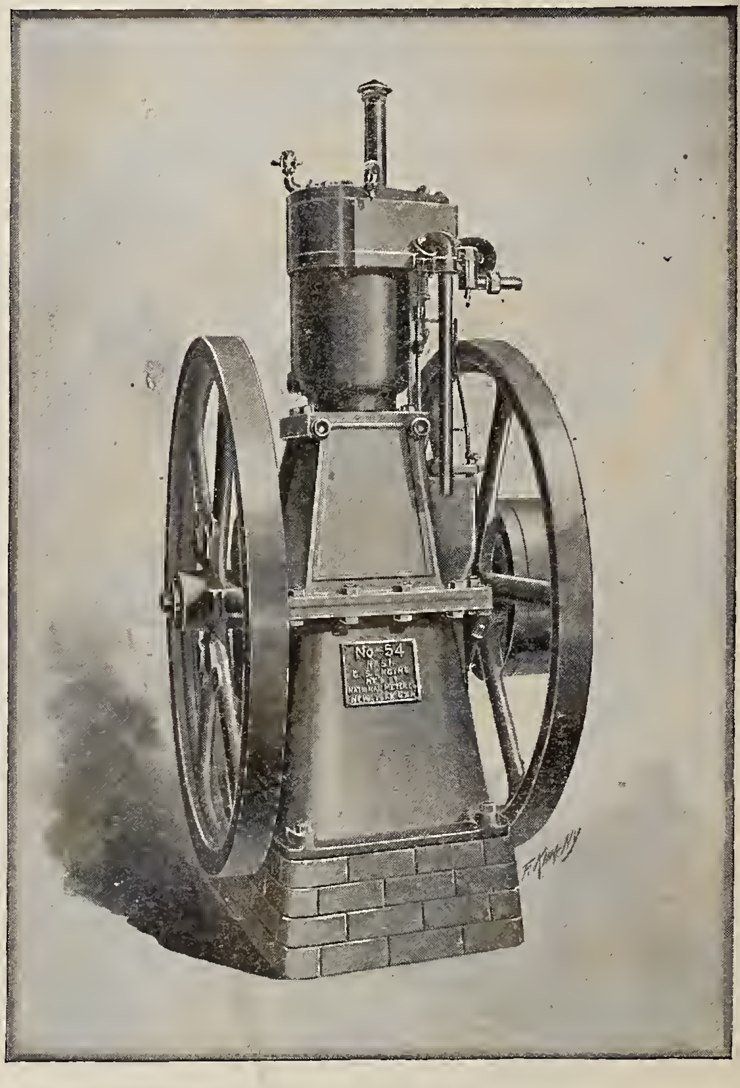
The plant was installed by J. Jones & Son, 65 Cortlandt street, New York, and the excellent manner in which it was done reflects great credit upon this well-known house. It is first-class and finished installation in every detail. All of the electrical apparatus and appliances were furnished by this firm.

We are informed that the National Meter Company has just closed a contract to supply two 200-H.-P. Nash gas engines for a suburban electric railroad plant, and has on hand an order for two engines for a 1,000-light plant in New York City.

DR. PUPIN LECTURES ON X-RAYS.

Dr. M. I. Pupin, of Columbia College, on Thursday night, February 19, delivered a special lecture before the third class of the School of Mines on Röntgen X-rays. He began with the statement that when a current is produced in a vacuum three phenomena are manifested—heat, fluorescence in the glass and radiant energy; that this is detected by a photographic film, some of the rays being cut off and shadows shown on the film. This describes in a general way the Röntgen experiment.

Dr. Pupin then began the history of currents in vacua, beginning with Faraday's experiments. Faraday found that if a current were produced in a vacuum tube, having the positive and negative terminals of the circuit fastened one to each end of the tube, a luminous discharge took place. He also found that the rays coming from the positive terminal (anode) stopped before they reached the rays coming from the negative terminal (cathode), leaving a space, known as Faraday's dark space.



NASH GAS ENGINE.

This discovery, made in 1828, was followed in 1850 by the construction by Hittorf and Geissler, of Bonn, of the famous Geissler tubes, in which the luminescence was produced in a striated form. It was then found that by diminishing the electric pressure until the luminous effect had almost disappeared, the fluorescence on that part of the tube opposite to the cathode rays was greatly increased. Spottiswoode and Crookes continued their experiments along these lines, Crookes manufacturing his "Crookes's tubes." Then followed the discovery by Goldstein that the cathode rays were affected by a magnet.

In 1891 Hertz found that if a substance were exposed to cathode rays it cast a shadow. Metals were found to have the property of allowing the cathode rays to go through them, particularly aluminum. In 1893 Dr. Paul Lenard found that cathode rays could be made to pass into air. The final discovery was then made by Röntgen of a ray that was not affected by the magnet and which would go through metals.

Dr. Pupin stated that the necessary time exposure of the plate in the now famous experiment varied from three minutes to an hour. He also stated that the rays would probably be of great service in metallurgy as well as in surgery, mentioning the possibility of distinguishing in a non-homogeneous mass of metal the various constituent metals.

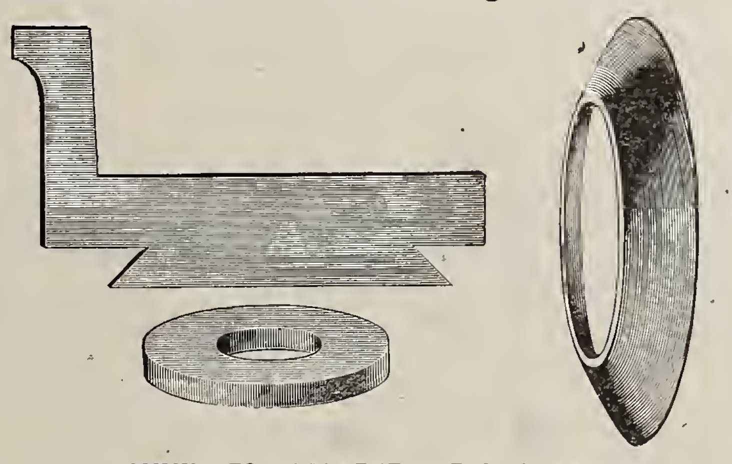
PRINCIPLES OF DYNAMO DESIGN.

BY

Newton Harrison E.E.

(*Continued from page* 89.)

In the construction of commutators several important points manifest themselves, and, perhaps, the most necessary of all would be the requisite cross section to the bar, or series of segments carrying the current; to which would be added the proper bearing surface of the brush conveying the energy from the machine to some outside circuit. The success of a commutator depends upon its wearability as a metal, for it has been demonstrated that even with like metals the friction varies according to the process through which each has been put. It might then be summarized as below, that the durability of all commutators depends upon the closest of attention to the following conditions :



COMMUTATOR SEGMENT AND WASHERS.

Cross section of segment,
External surface of segment,
Material of segment,
Circumferential speed of segment,
E. M. F. between segments,
Insulation between segments,
Mechanical strength of segments.

These factors always determine its lasting properties, and, because of the fact that the most visible wear is experienced, as well as some of the most flagrant sources of trouble, at this portion of the dynamo, it is undoubtedly the part to which the closest attention should be most earnestly given. Commutators, like the slide valves of engines, have gone through a process of development such that an almost universal experience has moulded the pre-existing forms into a somewhat common and fairly simple piece of mechanism.

It being but a mechanical problem as much as the boring of a field or the fitting of a shaft to produce a commutator of the proper rigidity and strength; the fineness of finish and perfection of the present machine-shop appliances has enabled manufacturers to construct commutators with accuracy and unequalled elegance. Taking the most evident fact as that requiring the first attention, the best cross section of a commutator bar at once meets with consideration.

According to the rating of wires of different cross sections the number of amperes per square inch usually lies between the limits of from 1,000 to 4,000. The current density in the wire is solely determined by the conditions governing its use. A wire in a coil may have its current density per square inch varied according to the depths of the coil, and when strung through the air the temperature of that locality taken as an average would again limit this quantity. In commutators an even greater precaution must be taken because of the fact that not only would an intense heat at the commutator quickly ruin the brushes and armature by simple transmission, but it would cause the soldered connections to fly out and be further exaggerated by any increase of speed (which would naturally mean more brush friction). There is a point, therefore, at which freedom from abnormal heat is experienced, provided the cross section be sufficient for the current and no very high rate of speed be permitted.

(*To be Continued.*)

WHAT ARE THE BEST CONDITIONS FOR THE PRODUCTION OF X-RAYS ?

In the production of X-rays the apparatus itself bears an important relation to the results. In discussing this phase of the subject an English contemporary says : So far as can be ascertained at present, very much depends upon the quality of the glass of the vacuum tube, German glass transmitting the radiations much better than English. Also, it is most important to have a very high degree of exhaustion. As to the minimum conditions for an effective discharge, nothing seems to be known, some of the apparatus described being, like Mr. Campbell Swinton's, excessively complicated, while other experimenters appear to have succeeded to a certain extent with simpler appliances. Prof. Murani, of Milan, has worked with a Ruhmkorff coil and 20 Bunsen cells. Using a Crookes tube of about 10cm. diameter, and having three anodes and one cathode, he obtained the Röntgen photographs with an exposure of 15 minutes. As other experimenters have succeeded with much shorter exposures, the matter is probably a question of degree. In the laboratory of Messrs. Siemens and Halske at Berlin, Dr. Neuhauss is stated to have obtained excellent results—not only with a Hittorf tube pumped empty of air, but also with the pear-shaped glass of an ordinary electric incandescent lamp. The metal wire leading to the carbon thread was used as an anode, and a metal plate outside the glass as the cathode. The glass shone with a bluish light when the current passed through it. On the other hand, Prof. Slary, of the Charlottenburg Technical Academy, has adopted a Lenard tube containing a thin aluminium plate at the part of the tube struck by the cathode rays. Such a tube is not easy to manufacture, but would be doubtless more effective.

POPULAR LECTURE ON X-RAYS.

Prof. M. I. Pupin, of Columbia College, will, on March 24, deliver a lecture before the Electrical Department of the Brooklyn Institute of Arts and Sciences, on "The Röntgen Cathode, or X-Rays." The lecture will be given in Association Hall, Bond and Fulton street, at 8 P M., and will be illustrated by experimental demonstrations and lantern "kathodographs."

DEATH OF MR. EDISON'S FATHER.

Samuel Edison, father of Thomas A. Edison, died in Norwalk, Ohio, on February 26, aged 92 years. He was born in Nova Scotia, August 11, 1804, and had lived at Milan, O., and Port Huron, Mich., the greater part of his life.

PRAISE FOR OUR ELEMENTARY DEPARTMENT.

The Electrical Age has a department of elementary education in electricity which is being made much of by the readers of that valuable weekly. We commend it to our young readers. — *Kansas City Architect and Builder* for February.

WHAT ARE X-RAYS?

Prof. Oliver J. Lodge, lecturing at University College, Liverpool, has referred to the possibility that the X-rays were ultra-violet light, high up in the scale of the spectrum. If so, it was probable, judging from their effects, that the rapidity of their vibration was a million times greater than that of ordinary light, or about as much more rapid than light as light was more rapid than sound. There was some evidence in favor of this, since the rays were able to diselectrify negatively-charged bodies. At present, however, he felt inclined to adopt the more sensational theory, that those rays were longitudinal waves in the ether. If so, the discovery would open up a department of physics as large as light, sound, or electricity.

Prof. Schuster, referring to a corpuscular hypothesis, pointed out the fact that Newton having held that fine particles of light could pass through opaque substances. Light and sound were transmitted with differing speed through varying substances; but here, however, were rays which seemed to go at almost the same speed through everything, and which were not acted upon by a lens. There was a feeling on the part of physicists that in these rays we were on the eve of a discovery of something which would link the hitherto isolated force of gravity with that of the higher forces of nature. The general opinion on the Continent appears to be in favor of the longitudinal vibration theory.

NEW ELECTRICAL SOCIETY IN BROOKLYN.

A meeting was held at 17 Whipple street, Brooklyn, Friday evening, February 28, to complete the organization of a society of electricians.

The name decided upon was "The Electrical Association of Brooklyn."

The objects of the association will be the promotion and study of the arts and sciences connected with the electrical and allied industries, and the welfare of those interested in the same, also the maintenance of rooms and the procurement of apparatus and literature for their use.

The association shall consist of associate and active members.

A committee was appointed to select rooms and to act as a committee on membership.

Any further information regarding the association will be furnished by addressing the Secretary, Mr. M. R. Rodrigues, 17 Whipple street, Brooklyn, N. Y.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

At the meeting of the institute February 26, the report of the Committee on Incorporation was read, and a resolution empowering the Council to proceed with the work of incorporation was unanimously adopted.

The discussion of Mr. Sprague's paper on electric elevators was reopened by Mr. Hutchinson who presented the results of actual tests made. He was followed by Messrs. Geo. Hill, R. P. Bolton, H. Ward Leonard, and others.

At the meeting of Council in the afternoon the ten Associate Members were elected, and six Associate Members were transferred to full membership.

THE GENERATION AND DISTRIBUTION OF CURRENT BY AN EDISON STATION.

A largely attended meeting of the New York Electrical Society was held at the Duane Street Station of the Edison Electric Illuminating Company, of New York, on the night of February 27.

A paper was read on "The Generation and Distribution of Current by an Edison Station, after which the members were conducted through the building on a tour of inspection.

The meeting was one of the most enjoyable ever held by the society, and was exceedingly helpful to those who attended, as it gave them an insight into the great industry that they probably could not have otherwise obtained. A collation was served to the visitors after the reading of the paper.

This society is doing good work in its "object-lesson" methods. Practical operation of electric machinery is what is taught, and that is just what is needed.

JOURNAL OF THE WESTERN SOCIETY OF ENGINEERS.

We have received a copy of the first issue of the Journal of the Western Society of Engineers, Chicago. It contains valuable papers, discussions, abstracts and proceedings, and is liberally illustrated with half-tones, charts, diagrams, etc. The supplement consists of valuable profile charts of the proposed water-way between Duluth and the Atlantic Ocean. This journal will be published bi-monthly by the society, at 1737 Monadnock Block, Chicago.

BI-METALLIC WIRE.

The Bi-Metallic Electric Transmission Co. has opened its office at No. 1204 Havemeyer Building 26 Cortlandt street, New York, N. Y. It is the intention of this company to place bi-metallic wire upon the market—the wire being composed of copper and steel, steel core with copper sheathing, combining great tensile strength with conductivity and, at the same time, securing to the user the "bi-metallic effect. The wire sold by this company is manufactured for it by the John A. Roebling's Sons Co. and is claimed to be perfect mechanically as well as electrically.

ELECTRIC HEATING.

After six months of negotiation the absorption of all the important electric heating companies has been effected by the American Electric Heating Corporation, Sears Building, Boston, and the control of the new consolidation will pass into the hands of a syndicate composed of well-known persons.

The new board of directors will include: J. Murray Forbes, (president); Charles A. Morss, Jr., Edward C. Perkins, Charles L. Edgar, of the Edison Electric Light Co., and S. S. Wheeler of the Crocker-Wheeler Electric Co.

The concerns absorbed by the American Co. are: The Western Electric Heating Co., St. Paul, Minn.; The Central Electric Heating Co., New York; The New England Electric Heating Co.; The Burton Electric Co., Richmond, Va.; The Carpenter Electric Heat Mfg. Co., St. Paul, Minn.; The Dewey Electric Heating Co., Syracuse, N. Y.; The Rich Electric Heating Co., Mt. Vernon, N. Y., as well as several others which have not been active in the business for some time, but which owned valuable patents.

Heating by electricity is now a commercial success, and in addition to the large number of patents now owned by the American Corporation, it also owns the patents covering the enamel process, which has already proved of great value in rheostats, and it is believed will be of equal importance in many other devices.

The policy of this company is to furnish the best that the state of the art will permit, and they are provided with an able corps of practical men and ample capital to insure this.

The manufacturing will be concentrated at Cambridgeport, and the head office is at 611 Sears Building, with agencies in New York and Chicago. Mr. James I. Ayer, ex-president of the National Electric Light Association, is the general manager.

CAR WIRING.

The Interior Conduit and Insulation Company, New York, is sending out to street-railway companies and car builders in the United States a circular on the subject of the wiring of railroad cars for electric lighting and power.

"The system we are promoting," the circular says, "relieves you from all the annoyance, discredit and dangers attendant upon the past methods of wiring, and instantly commends itself to railroad companies, car builders and electrical engineers on account of its simplicity, durability and economy.

"Our method consists of a system of insulating waterproof and electrically fire-proof tubes which may be concealed in the framework of cars after the manner of gas pipes. These tubes are run from roof of car to motors, controllers and all lamp outlets in the car, thus making a complete insulated race-way for all wires. The dangers resulting from the accidental overheating or, perhaps, melting of wires, and the consequent liability to destruction from fire, is completely eliminated by the use of our system. The wires are perfectly accessible at all times and in the event of the failure of any circuit from any electrical derangement the defective wire may be withdrawn and a new one substituted in its place without removing the wood-work or defacing the interior finish of car. The system we offer you insures absolute immunity from fire, accessibility to concealed wires, durability of insulation, reliability and economy."

PERSONAL.

Mr. J. H. Reid, the Chicago representative of the Westinghouse Glass Factory, Pittsburgh, Pa., was in town last week.

Among other well-known gentlemen in the city last week were Edwin Scribner, of the Western Electric Co., Chicago, and James Franklin, of the Commercial Electric Co., Chicago.

Mr. T. F. O'Connor, who for the past eight years has been connected with the Standard Underground Cable Co. of Pittsburgh, Pa., has accepted the position of assistant general manager of the National Underground Cable Co. of New York. The latter company is fortunate in securing the services of so valuable a man as Mr. O'Connor is.

TWO MEN FATALLY SHOCKED.

Jesse Tracey, 55 years old, and his son, Jesse Tracey, Jr., 24 years old, were killed in Providence, R. I., on February 25, by grasping a live wire that dangled in their yard in Thornton, a village about two miles out of the city.

The wire was an old telephone wire that had broken down and hung from the pole for several days in the way of pedestrians, one of whom picked up the end and threw it over the bars of Tracey's yard. The wire crossed an light wire and became charged with a powerful current.

Tracey attempted to remove the wire and took hold of it, when his body became rigid and he fell. His son went to the father's rescue, and in trying to remove the wire he also received a fatal shock.

NEW TELEPHONE BUILDING.

The Metropolitan Telephone and Telegraph Company has completed plans to erect a building on Dey street, in extension of its present building, No. 18 Cortlandt street. The new building will practically extend the old one through the block. It will be 16-stories high The rapid growth of the telephone business has caused great crowding in the present quarters, and in order to obtain more room the new building was decided upon.

INTERESTING EXHIBITS FOR THE ELECTRICAL EXPOSITION.

The public will have an opportunity to witness the new method of photographing through solids at the electrical exposition to be held in New York City in May, in connection with the nineteenth convention of the National Electric Light Association. Mr. Edison has succeeded in making a picture through eight inches of yellow pine, and anticipates no trouble whatever in making instantaneous shadowgraphs. He has generously offered to send to the exposition his most powerful and improved apparatus for making shadowgraphs, and his own corps of laboratory assistants to operate same.

Mr. Edison will also send to the exposition his large collection of experimental apparatus and designs pertaining to his early work on his numerous inventions, much of which has never yet been shown to the public.

NATIONAL ELECTRIC LIGHT ASSOCIATION CONVENTION.

NOTICE TO DELEGATES.

The Trunk Line Association have granted a rate of a fare and one-third for the round trip from points in their territory, to delegates attending the nineteenth convention of the National Electric Light Association, to be held in this city May 5, 6 and 7, 1896.

The convention will be held in a hall most admirably adapted for the purpose, in the Industrial Building, Forty-third street and Lexington avenue, during the progress of the great electrical exposition.

NEW BOOKS.

Synopsis of Current Electrical Literature, 1895. By Max Osterberg, E. E., A. M. D. Van Nostrand Co., New York. Price, $1.00.

Mr, Osterberg's excellent synopsis of electrical literature, which has been running in *Electric Power* for the past year or more, has been put into book form for convenience. The matter is well arranged, and indexed, and the book will no doubt be very valuable to students, writers and practical electrical engineers, as any subject with the scope of the work can be formed easily and at once.

Practical Information for Battery Users and About Telephones, with an appendix on the New Photography. Pamphlet. By Theo. F. Taylor. Price $1.00.

This work contains valuable information concerning batteries—how to produce large currents; how to make a dry battery; how to make chromic acid and new solutions, etc., etc. It also contains every recipe of practical value. Much valuable and plain imformation about telephones is given. The work is prepared in the simplest language, so that it will be perfectly understood by the uninitiated.

The above named books, and all others on electrical and kindred subjects, are for sale by the Electrical Age Publishing Co., World Building, New York.

Any book sent free by post on receipt of price.

FINANCIAL.

The New Orleans Traction reports gross earnings for January of $106,483, an increase of $13,825 as compared with the same month of last year, and net $49,944, an increase of $15,779.

The Second Avenue Railroad Company, New York, reports for the quarter ending December 31, gross earnings, $218,798, a decrease of $7,502 as compared with the same period of the previous year; net earnings, $41,608, a decrease of $190. The surplus account shows an increase of $121.

New Corporations.

New York City.—Standard Electric Lamp and Novelty Co.; capital, $10,000. Directors: Charles R. Folwer, William R. Powell, 1160 Broadway, and E. S. Lawrence, Jr., of New York City.

Yonkers, N. Y.—The Yonkers and Tarrytown Electric Railroad Co.; to operate a street surface railroad thirteen miles long, from Yonkers to Tarrytown. Capital is $750,000, and the directors are James H. Edwards, John H. Ingram, Frederick B. Hawley and Otto Ross, of New York City; John F. Van Name, Edgar C. Moxham, Edward P. Walker and Charles L. Calhoun, of Bridgeport, Conn.

Harrisburgh, Pa.—The Centralia, Ashland and Locust Gap Railroad Co., capital, $36,000, was chartered. The road will be six miles in length and will run through the borough of Centralia to Conyngham Township Electricity will be the motive power. Albert L. Lambertstine is the president.

Chester, Pa.—A charter has been granted the Chester and Marple Electric Railway Co., which will connect South Chester, Eddystone, Leiperville, Milmont, Swarthmore and Marple. Among the incorporators are District-Attorney V. I. Shaffer, Lawyer Josiah Smith, Alderman Thomas N. Berry and Editor W. C. Sproul, of the Chester *Times*.

Ottawa, Ill.—Electric Street Railway Co.; capital stock will be $25,000.

New York, N. Y.—Direct Current Transformer Co. has been incorporated by Alfred D. Warren, P. B. Welsh, W. A. Spellman, New York; F. D. Goold, George Stanmore, Brooklyn; to manufacture electrical devices and install machinery. Capital stock, $60,000.

Baltimore, Md.—The Autographic Telegraph Co.; capital, $1,000; incorporators, Edwin F. Abell, Michael Jenkins, Richard Cromwell, B. L. Deford and Arthur Stuart.

Telephone Notes.

Meridian, Miss.—Capt. Gallagher, of Meridian, is at Waynesboro for the purpose of establishing a telephone line between Waynesboro and Meridian, a distance of 55 miles.

Bellaire, O.—The Ohio Valley Telephone Co. of Bellaire has been incorporated with a capital of $10,000.

Persia, Ia.—A telephone line will be extended from Persia to Logan in the spring.

Bardstown, Ky.—Balltown, New Haven and Bardstown are soon to be connected by telephone.

Galesburg, Ill.—There is some prospect that Galesburg will have a new telephone system. Hon. Tom Marshall, of Keithsburg, is projecting a plan to extend a line from Monmouth to Galesburg.

Sharon, Pa.—The Mercer Telephone & Telegraph Co. was organized. Capital, $25,000. Directors: Hon. G. W. Wright, B. Magoffin, H. H. Ziegler, Dr. L. R. Heath and others.

Hartford, Conn.—A certificate of organization of the People's Telephone Co. was filed. The company was organized at New Haven. Capital, $2,500. Incorporators: George W. Coy, Milford; Joseph Sheldon, J. J. Rogers and James R. Bolton of New Haven.

Eagle Grove, Ia.—Eagle Grove is to have a telephone exchange.

Grantsburg, Wis.—A telephone line is now proposed from Grantsburg to Trade Lake, in Burnett County.

Laramie, Wyo—It is reported that a telephone line will at once be constructed from the Table Mountain mines to Laramie.

Sebree, Ky.—It is expected that Sebree will have telephone connections with Dixon shortly.

Armstrong, Ia.—Armstrong is to have a local telephone exchange.

Ghent, Ky.—A long-distance telephone is soon to be established at Ghent.

Middlesboro, Ky.—The Middlesboro and Pineville Telephone Company is to build a new line in the former city at once.

Athens, Ga.—The Athens Telephone Exchange will erect a three-story brick building in that city.

TELEPHONE PATENTS ISSUED FEBRUARY 25, 1896.

Short-Distance Telephone Communication. Walter L. Bradshaw, Cincinnati, Ohio. (No. 555,073.)

Telephone Transmitter. Alfred Graham, London, England. (No. 555,154.)

Railway Telephone System. Wm. H. Nixon, Providence, R. I. (No. 555,222.)

Telephone. Manious Garl, Akron, O. (No. 555,239.)

FOR UPTOWN TELEPHONE SUBSCRIBERS.

An uptown branch of the Contract Department of the Metropolitan Telephone and Telegraph Company has been established at 113 West 38th street (one door from Broadway), where all business relating to the supply of telephone service can be transacted as readily as at the main office at 18 Cortlandt street. There are 14,000 telephone stations in New York City. Metallic Circuit Service, Rapid, Efficient, Permanent can be had from $75 a year.

Possible Contracts.

New York City.—Alterations are to be made to the Vanderbilt Building, corner of Nassau and Beekman streets, to cost $400,000.

A three-story brick office building is to be erected by the Whitehead Brass Co., of 517 West 15th street, to cost $7,000.

Hollidaysburg, Pa.—The Hollidaysburg Council has voted to issue a $12,000 loan for the establishment of an electric light plant to be owned by the city.

New York City—Weil & Meyer will build a two-story brick and terra-cotta front music hall, at Willis avenue and 147th street.

Montague, Me.—Herbert Averill, manager of the Postal Telegraph Co., also electrician for Howland Falls Pulp Co., is making arrangements for a telephone exchange which will extend its services throughout this section, and would be pleased to receive quotations, from reliable dealers, on telephones and supplies.

Binghamton, N. Y.—It is reported that the Binghamton Railroad Co. have purchased a lot on the corner of Main and Elizabeth streets, of James Sullivan, for the purpose of erecting a depot and express station on that site.

Philadelphia, Pa.—The Knights of Pythias of Pennsylvania have decided to erect a temple in this city, on Market street, at a cost of $250,000. The matter has been under consideration for some time. A committee consisting of Thomas E. Merchant and John M. Stratton, of Philadelphia; Geo. W. Miles, Danville; D. F. Brindle, Carlisle, and C. M. Deem, of Reading, was appointed.

Syracuse, N. Y.—W. Judson Smith, J. S. Kaufman, and others have applied for a street railway franchise in this city.

Niagara Falls, N. Y.—Geo. W. Hawley is building a four story hotel at Niagara Falls. It will be completed by April 1, and will cost about $40,000.

West Hampton, L. I., N. Y.—Charles Winslow will soon begin the erection of a hotel, to cost about $20,000.

Providence, R. I.—The Union Station at Providence, which was destroyed by fire at a loss of $25,000, will be replaced by a new structure, which will cost about $1,000-000.

New York City.—Jeremiah C. Lyons, 67 East 127th street, will erect a twelve-story brick store and warehouse at 491 to 493 Broadway, at a cost of $195,000.

Fulton, N. Y.—The Fulton and Oswego Falls Street Railway Co. will apply for a franchise and ask for permission to build and operate an electric road in certain streets of the village.

New York City.—A six-story brick warehouse and store is to be erected by the estate of Henry Bruner, 56 Broadway, at 115 to 121 Wooster street, at a cost ot $135,000.

The old Clearing House building and site, at the corner of Pine and Nassau streets, have been sold to Treasurer John E. Searles of the Sugar Trust, and a new bank building will be erected in its place connected with the Equitable Assurance Society.

Berryville, Va.—The Senate passed a bill to empower the town of Berryville to construct an electric light plant.

Wilkesbarre, Pa.—Hess, Goldsmith & Co., of the silk mills at South Wilkesbarre, have decided to double their present plant. The concern will also erect its own electric light plant.

New York City.—The National Bank of Commerce, corner of Cedar and Nassau streets, will erect a new modern fire-proof structure. The work of demolishing the old building will begin on May 1.

Edward E. Bailey, 132 Nassau street, will erect a six-story brick warehouse at 220 and 222 East 125th street, at a cost of $35,000.

Trade Notes.

The "W. & S. Hydraulic Machinery Works," 204–210 East 43d street, New York, have just issued the 1896 edition of their Jack catalogue. Their Jacks are made in standard sizes and shapes. Their electric motor lift is largely used by electric railway companies. A copy of the catalogue can be had by mentioning the Electrical Age, in applying for the same.

Mr. W. H. Fleming, 393 Pearl street, New York, manufacturer of gauze wire dynamo brushes, has received a letter from David Howe, electrician for Reed & Barton, Taunton, Mass , very complimentary of Fleming brushes. Mr. Howe states that the wear of the woven-wire dynamo brushes on three machines in use from one to two years averages about one-half an inch yearly. With the commutator in proper condition, he says, and the brushes correctly adjusted, the wear is hardly noticeable.

ELECTRICAL and STREET RAILWAY PATENTS

Issued February 25, 1896.

555,068. Electric Car-Lighting Apparatus. William Biddle, Brooklyn, N. Y. Filed Dec. 24, 1894.

555,073. Short-Distance Telephone Communication. Walter L. Bradshaw, Cincinnati, Ohio. Filed Sept. 28, 1895.

555,074. Electric Transformer. William Carter, Louisville, Ky. Filed Apr. 23, 1895.

555,075. Brake Apparatus for Railway-Vehicles. François Chapsal, Paris, France. Filed Oct. 4, 1895. Patented in France June 4, 1894, No. 239,025, and in Belgium Feb. 26, 1895, No. 114,303.

555,076. Electric Visual Indicator. Frederick W. Cole, Newton, and Winthrop M. Chapman, Needham, Mass. Filed June 3, 1892.

555,083. Car-Fender. Robert S. Flint, Troy, N. Y., assignor of nine-twentieths to T. Henry Dutcher, same place. Filed Apr. 18, 1895.

555,090. Secondary Electric Clock. Fred L. Gregory, Chicago, Ill. Filed May 11, 1895.

555,101. Electric Annunciator. John Kips, Yonkers, assignor of two-thirds to Martin Geiszler, New York, and Adolf G. Hupfel, Johnsville, N. Y. Filed Jan. 8, 1895.

555,103. Car-Fender. William Leonhardt, Baltimore, Md., assignor to the Leonhardt Pneumatic Safety Car Fender Company, same place. Filed Oct. 13, 1894.

555,112. Hanger-Board for Arc Lamps. August J. Oehring, Chicago, Ill., assignor to the Western Electric Company, same place. Filed Sept. 18, 1894.

555,114. Circuit Controlling Apparatus for Scenic Theaters. August J. Oehring and Albert L. Tucker, Chicago, Ill., assignors to the Western Electric Company, same place. Filed May 13, 1895.

555,119. Car-Fender. Simon A. Politsky, Boston, Mass. Filed May 20, 1895.

555,120. Electrical Annunciator. Frank Porath, Appleton, Wis. Filed July 6, 1895.

555,130. Electric Welding Indicator. Elihu Thomson, Lynn, Mass., assignor to the Thomson Electric Welding Company, of Maine. Filed July 23, 1888.

555,131. Electric Riveting. Elihu Thomson, Swampscott, Mass., assignor to the Thomson Electric Welding Company, of Maine. Filed Oct. 20, 1890.

555,136. Electric Elevator Controller. Ernest P. Warner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed Oct. 29, 1892.

555,145. Trolley Wheel Switch. Philip A. Williams, Decatur, Ill., assignor of one half to Francis F. Williams, same place. Filed June 10 1895.

555,146. Wire-Twisting Machine. John A. Barrett, Brooklyn, N. Y., assignor to the Standard Underground Cable Company, Pittsburgh, Pa. Filed Nov. 2, 1889.

555,152. Constant-Potential Alternating Generator. Walter K. Freeman, Fort Wayne, Ind. Filed July 5, 1895.

555,154. Telephone-Transmitter. Alfred Graham, London, England. Filed May 3, 1894.

555,160. Electric Call and Alarm Apparatus. Jean P. Hartfuss, Merzig, and Ernst Herz, Saarbrück, Germany. Filed Feb. 14, 1895. Patented in Germany Feb. 4, 1893, No. 74,922; in Belgium Dec. 24, 1894, No. 113,-349; in France Dec. 24, 1894, No. 243,883; in Austria Dec. 29, 1894, No. 45/2,427; in Italy Dec. 31, 1894, No. 289; in England Jan. 3, 1895, No. 226, and in Switzerland Jan. 18, 1895, No. 10,605.

555,165. Telegraphic Repeater. Lewis Horton, Jr., Reading, Pa. Filed Dec. 14, 1895.

555,167. Electric Railway-Signal System. Joseph Irwin, Omaha, Neb. Filed Feb. 18, 1895.

555,190. Alternating Motor. Nikola Tesla, New York, N. Y., assignor to the Tesla Electric Company, same place. Filed May 15, 1888.

555,191. Electric Motor. Elihu Thomson, Swampscott, Mass., assignor to the Thomson-Houston Electric Company, of Connecticut. Filed Dec. 19, 1890. Renewed Oct. 22, 1894.

555,192. Electric-Lighting System. Sylvanus L. Trippe, New York, N. Y. Filed June 21, 1893. Renewed July 31, 1895.

555,199. Spark-Arrester for Arc Lamps. Charley Winston, Memphis, Tenn., assignor of one-half to E. F. Naegele, same place. Filed Feb. 28, 1895.

555,204. Car-Fender. Nicholas J. Bishoprick, Brooklyn, N. Y. Filed Dec. 7, 1895.

555,208. Conduit Electric Railway. Christopher M. Bridges, Seattle, Wash., assignor of one-fifth to John S. Fanning, San Francisco, Cal. Filed May 31, 1895.

555,216. Armature-Winding. Walter H. Knight, Schenectady, N. Y., assignor to the General Electric Company, of New York. Filed Apr. 13, 1895.

555,217. Electric Signaling Device for Railroads. Gustav A. Lyncker, Munich, Germany. Filed April 27, 1895. Patented in Germany July 25, 1893, No. 76,179, and in Austria-Hungary Aug. 17, 1894, No. 1,238 and No. 43,-886.

555,222. Railway Telephone System. William H. Nixon, Providence, R. I., assignor to the Nixon Telephone and Electrical Construction Company, of Rhode Island. Filed Jan. 28, 1895.

555,232. Process of Manufacturing White Lead by Electrolysis. Arthur B. Browne, Cambridge, and Edwin D. Chaplin, Natick, Mass., assignors to the American Lead Company, Kittery, Me. Filed July 2, 1894.

555,239. Telephone. Manious Garl, Akron, Ohio, assignor of one-half to George W. La Vigne, same place. Filed Apr. 4, 1895.

555,243. Photographic Retoucher. Della M. Harshman, Chicago, Ill. Filed Feb. 1, 1894.

555,248. Electric Railway. William H. Jordan, Brooklyn, N. Y. Filed Jan. 17, 1896.

555,252. Electrical Propulsion of Vessels. Ernest A. Le Sueur, Ottawa, Canada. Filed Mar. 26, 1894.

555,259. Electric Heater. James F. McElroy, Albany, N. Y. Filed May 31, 1895.

555,263. Contact Device for Electrically-Propelled Vehicles. Emil B. W. Reichel, Gross-Lichterfelde, Germany, assignor to the Siemens & Halske Electric Company of America, Chicago, Ill. Filed Aug. 15, 1895.

555,266. Underground Conductor System for Electric Railways. Carl T. H. Schwieger, Berlin, Germany, assignor to the Siemens & Halske Electric Company of America, Chicago, Ill. Filed Nov. 15, 1895. Patented in Italy Sept. 28, 1895. No. 39,627.

555,283. Car-Fender. Uriah Dietz, Bangor, Pa , assignor of one-half to Amos Buzzard, same place. Filed Dec. 27, 1895.

555,286. Electrical Measuring-Instrument. Friedrich von Hefner-Alteneck and Hans Görges, Berlin, Germany, assignors to the Siemens & Halske Electric Company of America, Chicago, Ill. Filed Nov. 25, 1895.

555,291. System of Control for Electric Motors. Elmer A. Sperry, Cleveland, Ohio, assignor to the General Electric Company, of New York. Filed Feb. 16, 1895.

555,292. Car-Fender. Albert Steiert, Philadelphia, Pa. Filed Dec. 12, 1895.

555,297. Spark-Arrester. Gustaf A. Anderson, Waynesborough, Pa., assignor to The Geiser Manufacturing Company, same place. Filed Sept. 3, 1895.

555,301. Regulating Electric Distribution System. James Burke, Schenectady, N. Y., assignor to the Thomson-Houston Electric Company, Boston, Mass. Filed Oct. 24, 1894.

555,303. Primary Battery. Walter A. Crowdus, Chicago, Ill. Filed June 12, 1895.

555,304. Primary Battery. Walter A. Crowdus, Chicago, Ill. Filed Oct. 4, 1895.

555,305. Electric Lamp for Vehicles. Walter A. Crowdus, Chicago, Ill. Filed Oct. 4, 1895.

555,313. Electric Clock. Sigismund Fischer, Brooklyn, assignor of one-tenth to Victor D. Brenner, New York, N. Y. Filed May 10, 1895.

555,326. Electric Distribution System. Eugene C. Myrick, Providence, R. I. Filed May 23, 1893.

555,332. Electric Receptacle for Flashing-Powder in Flash-Light Burners. Henry E. Rathbun and Frederick Bebby, Pawtucket, R. I.; said Rathbun assignor to said Bebby. Filed Jan. 7, 1895.

555,381, Brush for Dynamo-Electric Machines and Motors. Friedrich W. Kreinberg, Elsey, assignor to Otto Hering, Berlin, Germany. Filed Feb. 17, 1894.

555,382. Car-Fender. Frank W. Lafferty, Philadelphia, Pa. Filed Oct. 19, 1895.

555,392. Electric Motor for Street-Cars. Harry M. Neer, Springfield, Ohio, assignor of one-half to Oliver S. Kelly, same place. Filed Apr. 25, 1895.

555,400. Car-Fender. Charles M. Pratt, Towanda, Pa. Filed Sept. 3, 1895.

555,403. Machine for Connecting Electric Conductors. Harlie J. Savory, Somerville, Mass. Filed Apr. 17, 1893.

555,440. Illuminated Sign for Electrically-Driven Street-Cars. Robert H. Engle, Garden Lake, N. J., assignor of one-half to Charles W. S. Munro, Philadelphia, Pa. Filed Mar. 8, 1895.

555,452. Process of and Apparatus for Electrolytically Forming Tubular Bodies. Ignatz Klein, Buda-Pesth, Austria-Hungary. Filed Dec. 7, 1894. Patented in Austria Mar. 19, 1892, No. 5,178; in Hungary Mar. 19, 1892, No. 4,785, and in Germany Mar. 31, 1892, No. 79,764.

555,470. Sectional Conductor for Electric Railways. William H. Baker, Pawtucket, assignor to Baker & Burnett, Providence, R. I. Filed Mar. 21, 1895.

ELECTRICAL AGE

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NEW YORK, MARCH 14, 1896.

CONTENTS.

REQUIREMENTS OF HYDRAULIC APPARATUS.

In view of the frequently occurring disputes between manufacturers of hydraulic apparatus and manufacturers of electrical apparatus, as used in power transmission plants, concerning the power actually delivered from one machine to the other, it becomes a matter of the highest importance for electrical engineers to acquire a full and clear insight into the essential requirements of hydraulic apparatus. On another page we print an article from Mr. F. M. F. Cazin, a well-known scientist, which throws considerable light upon this important subject.

THE COMING ELECTRICAL EXPOSITION.

The electrical exposition which will be held in this city next May is rapidly assuming the proportions and importance of a national affair. A large portion of the electrical manufacturing concerns and supply dealers are making extensive preparations to show their wares to the best possible advantage, and from what we learn many of them look upon this exhibition as worthy of their utmost endeavors to be represented as prominently as possible. In some instances much else is sacrificed for the success of the display on this occasion. There will be large exhibits and small exhibits; big things and little things; commonplace things and wonderful things, and above all there will be generous support for the great enterprise. The big show will last a month, but a month will likely prove too short a time, judging from the present and constantly growing enthusiasm. However, in the wisdom of the powers behind the throne one month has been decreed as the time limit, and every effort will be made to get the best results for all concerned. The exposition managers are handling the undertaking in a broad-minded and liberal spirit, and everything augurs well.

X-RAY POSSIBILITIES.

The popular excitement over the marvellous discovery of Prof. Röntgen and the applications of the same very naturally has had the effect of exciting the dullest minds into imagining what can be done with the rays. As yet, no one knows what the wonderful unknown rays will be able to accomplish and reveal. That they do reveal hidden things there is no question, and many persons of shady reputation perhaps feel a little uneasy as to whether their real characters cannot be revealed by the same agency. It probably would be a good thing for the community if the story of their lives could be taken and recorded by a snap-shot. But that is something for the future to deal with. The smartest minds of the imaginative class find the daily newspapers the best means for the exercise of their faculty, and if they possess, besides, the rare power of being able to express their mind-pictures in visible picture form they have a gold mine all to themselves. One of the cleverest pieces of artistic imaginative work was published by the New York *Herald* in a recent Sunday issue. The cartoonist expressed his ideas as to what the X-rays would be able to do, and what they could not do. One illustration showed a pretty young lady disembarking from a European steamer. She had a valise in each hand and was making a bee-line for the street when a very gallant, but dutiful custom house officer stopped her and informed her that she and her baggage must be photographed by the X-rays before she can be allowed to depart. Another picture shows a camera pointed at a plate of that inscrutable combination known as "boarding-house hash," with all of the half-starved boarders standing around waiting for the long-looked-for answer to the question "What is it?" The contents of a Harlem goat next attracts the eye. The ability of a goat to devour bill posters, tin cans and such delectable morsels is proverbial, but this Harlem goat has absorbed many things that are not usually classed as food for goats. They include a copy of "Trilby," a few old shoes, a part of a street pavement, besides the regulation quota of cans, hoop-skirts, etc. The question now stares us in the face—"if the X-rays can reveal all of these things, where will the thing stop?"

NEW ELECTRIC PUMPS.

The advantages afforded by the use of electric pumps wherever hydraulic machinery is used are well known to every one interested in such matters.

The electric pump is rapidly proving its valuable qualities for maintaining a constant pressure or output under varying conditions, or for providing an instantly available means of protection or special supply in case of emergency, either with or without automatic control.

One of the most valuable features of electric operation under these circumstances is the fact that a motor consumes current almost exactly in proportion to the load—in other words, though the speed may remain the same, the consumption of current (save enough to overcome the friction of its two bearings) ceases immediately upon the removal of the load, or in proportion as it is removed.

Our other illustration, Fig. 2, is of a triplex portable electric power mine pump, with single acting outside packed plungers.

While designed primarily for mining service, this pump is as well adapted for excavating and contracting purposes, where a pump must be moved at frequent intervals to keep pace with the progress of the work.

The plungers of this pump have a diameter of 6½ inches and an 8-inch stroke, the pump being driven by a 10 H.P. motor. This type of apparatus is capable of many modifications and special forms.

RATES FOR ELECTRIC LIGHT IN HELENA.

The Helena Power and Light Co., Helena, Montana, last month made public its rates for lighting. The following is the schedule :

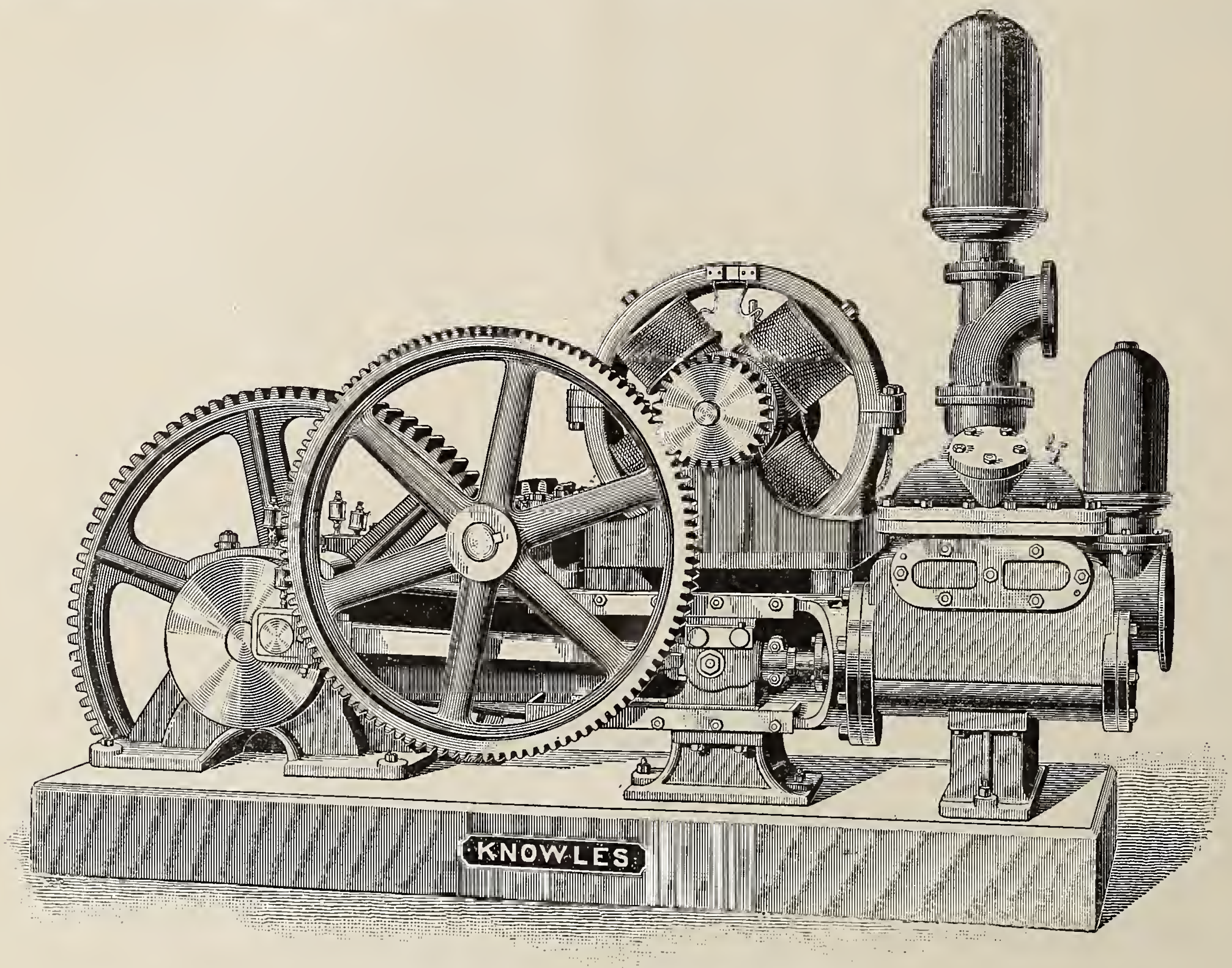


FIG. I.—HORIZONTAL DUPLEX ELECTRIC POWER PUMP.

For all purposes the electric power pump appeals alike to the engineer, the purchaser and the operator by its simplicity, compactness, freedom from complicated or concealed mechanism and general smoothness of operation.

We illustrate herewith two styles of electric pumps manufactured by the Knowles Steam Pump Works, 93 Liberty street, New York City.

Fig. 1 shows a horizontal duplex electric power pump of the double-acting piston pattern, for elevator service.

Owing to the compensating action of the pistons these pumps are especially adapted for hydraulic elevator service, either with a series-wound motor arranged to start and stop automatically as required by the varying pressure or level in the supply tanks, or provided with a by pass and automatic controlling valve, allowing the motor to run uninterruptedly. This plan is to be preferred whenever a practically continuous service is to be provided for, as it avoids the excessive wear and tear of frequent starting on switches and rheostats, while the increased economy of a constant speed motor more than compensates for the slight loss of power required to pump through the bypass loop during "full-pressure" intervals.

ARCS.

8 o'clock lights, each, per month	$8.00
10 " " " "	10.00
1 " " " "	14.00
All night " " "	17.00

INCANDESCENTS.

10 'clock lights, 16-candle power each, per month	$1.10
1 " " 16 " " " "	1.60
All night " 16 " " " "	2.20

METER RATES.

1,000 hours and under, per 100 hours	90 cents
1,000 to 2,000 hours, " 100 "	85 "
2,000 to 3,000 " " 100 "	80 "
3,000 to 4,000 " " 100 "	75 "
4,000 hours and over " 100 "	70 "
For residences	One cent per ampere hour

Dr. Werner Siemens first suggested the name "dynamo electric machine" for machines in which the self-exciting principle was employed.

MEASUREMENT OF RESISTANCE.

LESSON LEAVES

FOR

THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

In measuring resistance many methods have come into vogue, each applicable to a certain case and dependent upon circumstances for the results obtained and comparative accuracy.

Classes of Resistances.

Two classes of resistances may be measured, the methods in each case being changed to suit the conditions. They are constituted under the head of

Low resistance tests,
High " "

To find its resistance is not difficult if the above method is applied. Two factors must be known in such a case—the current and the pressure.

A sixteen-candle-power lamp having one-half an ampere and 110 volts applied to it would have the following resistance:

$$\text{Volts} = 110$$
$$\text{Amperes} = \tfrac{1}{2} = .5$$

By the rule—

$$\text{ohms} = \frac{110}{.5} = 220$$

Use of Wheatstone Bridge.

For the determination of resistances in general a Wheatstone bridge is employed. A bridge may be constructed for portable use or for stationary purposes, and the galvanometer attached is made as sensitive as the usage it receives will allow.

For portable use the needle is pivoted instead of suspended, and the sensitiveness of the galvanometer correspondingly decreased. When fine tests are to be made, whether of high or low resistance, the needle has a silk suspension and is affected by the slightest changes.

The tests made under such circumstances are less rough and more thoroughly accurate than otherwise.

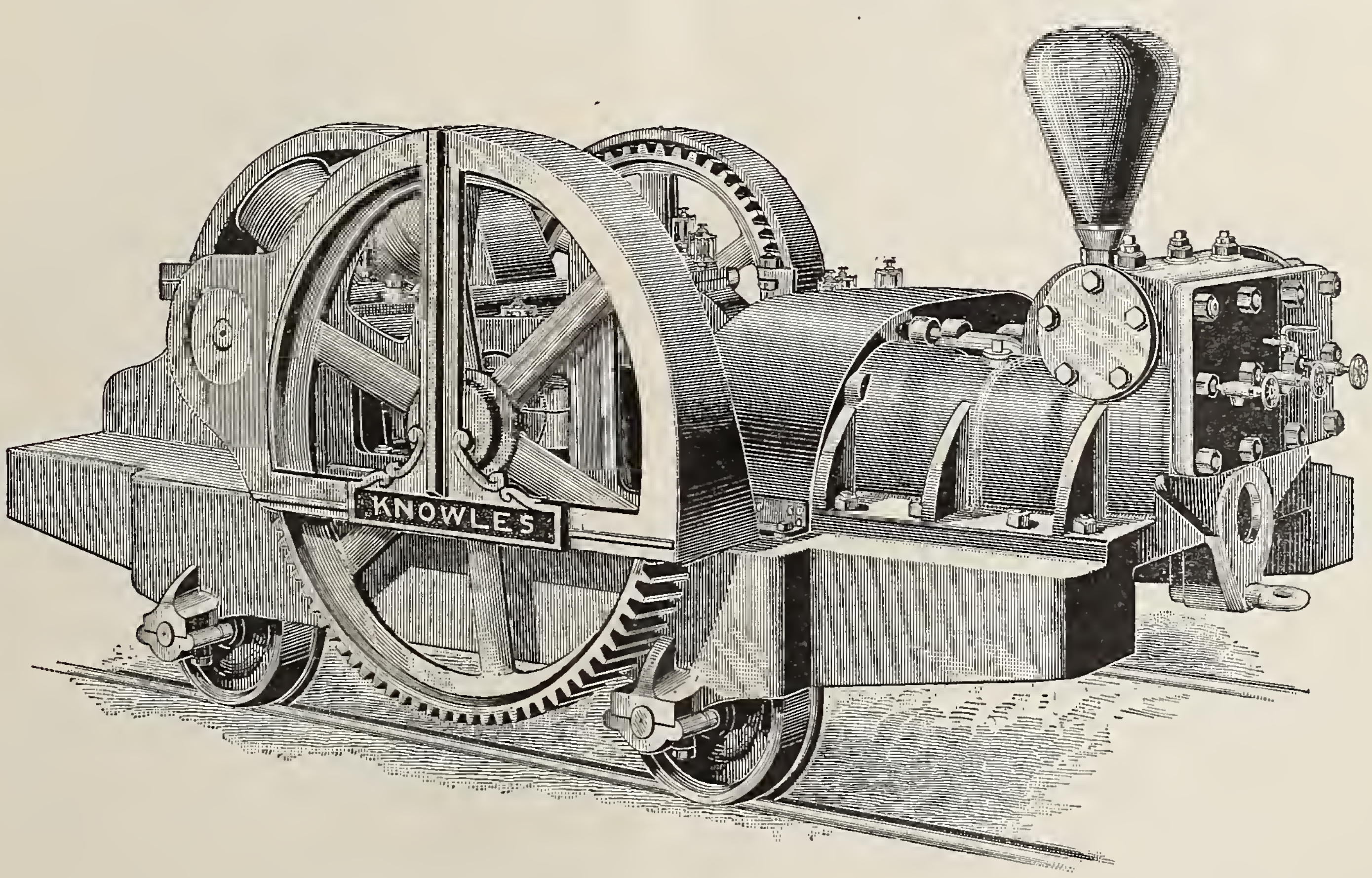


FIG. 2—TRIPLEX PORTABLE ELECTRIC POWER MINE PUMP.

Use of Ohm's Law.

In any measurement of resistance Ohm's law comes into direct application. The three quantities which completely determine the conditions are the current, electromotive force and resistance.

When two of these are given the third can be determined by simple calculation.

If, for example, a current of ten amperes be passed through a wire so as to cause a drop of potential or loss of pressure equal to five volts, the resistance of the wire is calculated as follows:

$$\left\{\begin{array}{l}\text{Current} = 10 \text{ amperes,}\\ \text{Pressure} = 5 \text{ volts.}\\ \text{To find ohms.}\end{array}\right\}$$

$$\begin{aligned}\text{By Ohm's law current} &= \text{volts} \div \text{ohms,}\\ \text{or resistance} &= \text{volts} \div \text{current,}\\ \text{therefore} \quad \text{"} &= 5 \div 10\\ &= \tfrac{1}{2} \text{ ohm.}\end{aligned}$$

Resistance of Incandescent Lamp.

This method is of especial interest when it is desirable to know the resistance of a body while hot. The carbon of an incandescent lamp does not have the same resistance cold as when incandescent; the resistance of carbon continually diminishes with heat.

Method of Substitution.

A simple method of measuring a resistance will be briefly described; it is called the method of *substitution.*

A galvanometer, battery and resistance are connected in series. The E.M.F. of the battery must remain steady and the resistance must be known in ohms. By thus connecting them a deflection occurs on the galvanometer which must be carefully observed. Supposing the conditions are as follows:

The resistance = 100 ohms.
" deflection = 50 degrees.

This being noted, the resistance of 100 ohms is removed and the unknown resistances *substituted* therefor.

If the unknown resistance be less, the deflection will be greater because more current will flow through it. If the unknown resistance be greater than 100 ohms, the deflection of the galvanometer will be less because less current passes.

Supposing, however, that the second deflection obtained with the unknown resistance equals 25 degrees, the results are tabulated thus :

(1st)	Resistance	=	100 ohms.
	Deflection	=	50 degrees.
(2d)	Resistance	=	unknown ohms.
	Deflection	=	25 degrees.

The rule to be applied is then as follows :

Known resistance : unknown resistance = 25° : 50°.

Care must be taken to remember which is the greater resistance—the one originally there or the unknown resistance. The galvanometer will indicate this by the deflection.

In this case the greater resistance is the unknown resistance, because it has only moved the needle through 25° ; it has therefore allowed less current to pass and possesses a higher resistance.

In the proportion

$$100 \text{ ohms} : \text{unknown ohms} = 25^\circ : 50^\circ$$

$$\text{Unknown ohms} = \frac{50^\circ}{25^\circ} \times 100 \text{ ohms.}$$

$$= 200 \text{ ohms.}$$

Resistance Boxes —In order that standards may be conveniently handled, resistance boxes have been constructed composed of reels of German silver wire.

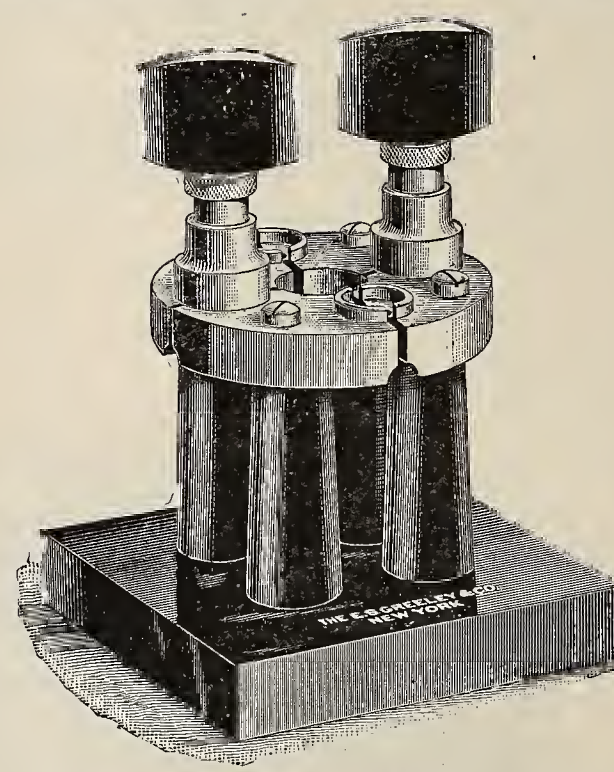
Standard Ohm.—The standard of resistance is the ohm; it has been made in two separate forms as a unit. One, the primitive form, is simply a mercury column of 106 3 centimeters in length and a given weight of mercury, the diameter being about 1 millimeter; and the other, called the B. A. unit, is composed of wire, either German silver or platinum-silver alloy.

The general construction of resistance boxes is as follows: A series of reels of German silver wire are placed within a box, and their individual extremities connected to metal pieces on the outside. The extremities of each coil end in two brass blocks separated from each other, yet allowing a plug to be inserted between them when necessary.

By means of this plug the coil can be left in or cut out. When the plug is inserted the ends of the coil are in metallic communication, and the only resistance is that experienced by the current when passing between the metal blocks. The extremities of each coil are individually marked with their corresponding resistances.

high or low resistances. The slide bridge, as seen in sketch, is utilized whenever it is desirable to measure very low resistances, the connections being the usual ones for a bridge test. When very low resistances are being tested, the differently heated currents of air passing at the time affect the bridge, giving rise in it at all its joints to thermo-electric currents. Protection against these is obtained by covering such parts with cotton-wool and keeping doors and windows closed.

The metallic piece on the bridge slides along a wire of alloyed metals and by its movement forth or back creates



DOUBLE PLUG KEY.

the proportional arms required for a balance of the bridge.

The two arms thus obtained by a division of the wire are not known in ohms but are considered merely as proportional parts of each other.

If the wire is fifty inches long, the point at which the slide rests gives the arms either 15 and 35, 20 or 30, or any other arrangement. The other two known resistances are inserted in the shape of resistance boxes and unplugged to the required extent. A galvanometer is connected across to the proper terminals and the absence of deflection denotes a balance.

The larger bridge of higher resistance sometimes comes

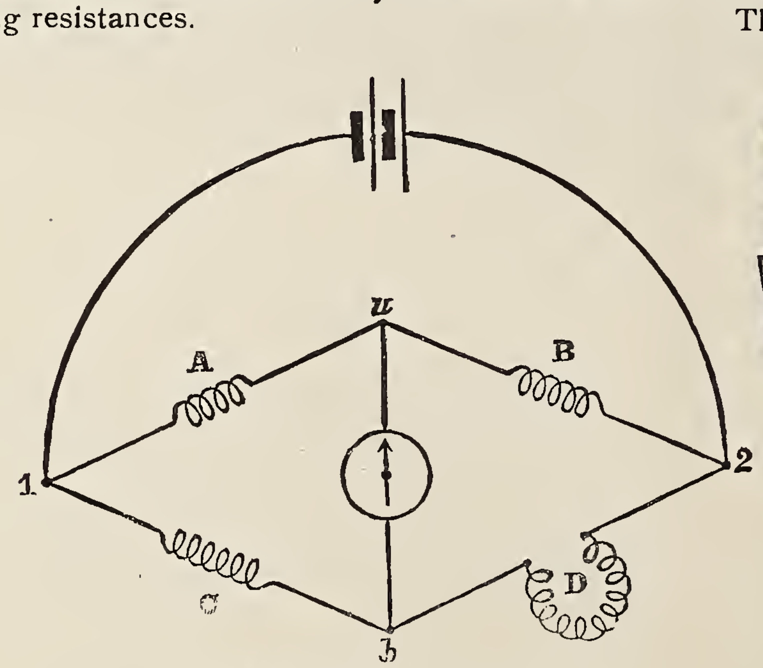
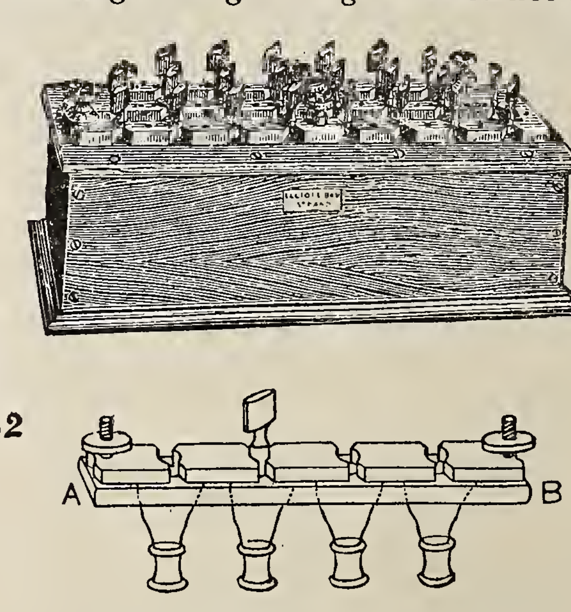


DIAGRAM OF WHEATSTONE BRIDGE.



RESISTANCE BOX AND SPOOLS.

The boxes are made of a resistance either great or small as desired. One box may read in tenths and units, another in units and tenths or hundreds and thousands, etc.

The resistance to be measured greatly determines the box to be used. With a 100,000 ohm coil very high resistances may be measured with the aid of a good galvanometer.

The Wheatstone bridge is used as in the above for either

in the form of a box called a post-office set, but its use does not vary in the least from that just described. The divided wire or meter bridges are excellent for low resistances. When greater resistances are to be measured, although the principle employed does not alter in the least, the means for effecting the same does considerably. A very great resistance usually requires a greater pressure with the same galvanometer than that hitherto employed. Thus testing cells of chloride of silver are very convenient when from 50 to 100 volts is necessary in such work.

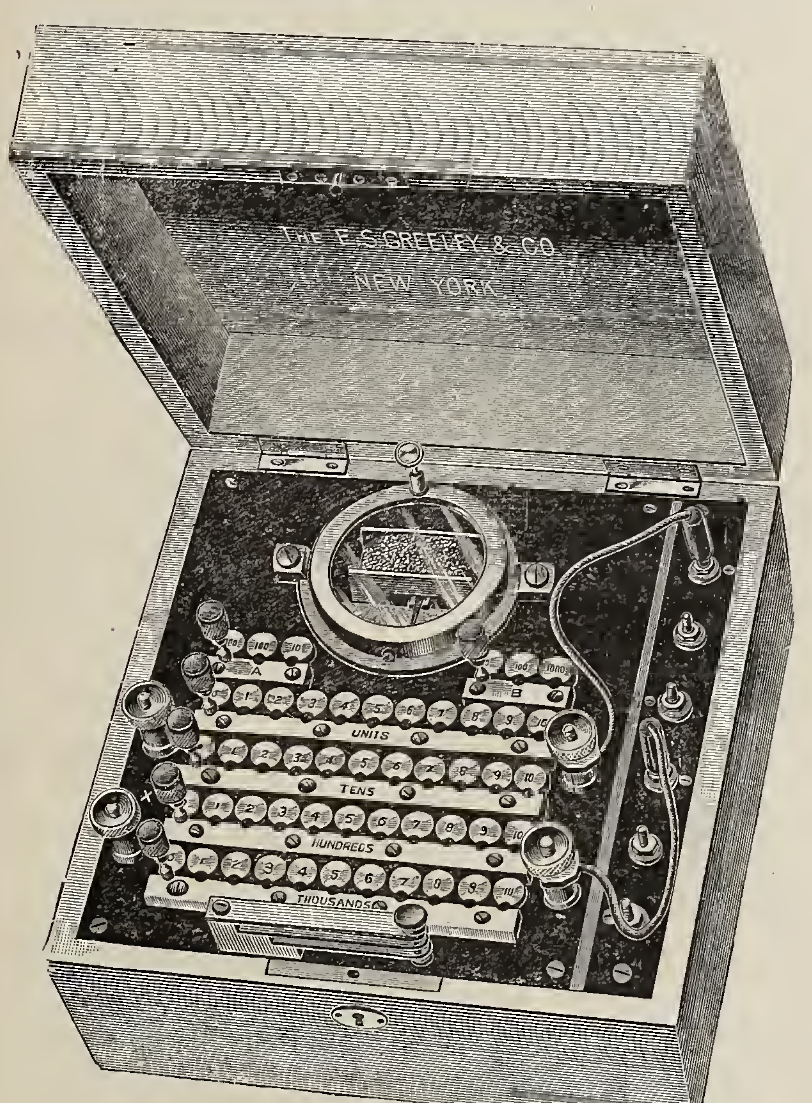
The insulation resistance of a wire is the number of ohms resistance of its outer covering. This, as a rule, is so high that it is not measured in single units but in groups of 1,000,000 ohms apiece. These larger units are called megohms.

The process of substitution for the measurement of insulation resistance is very convenient if, instead of a galvanometer, a Weston voltmeter be utilized.

The volts are noted and the resistance of the voltmeter as given on the cover. If the volts read off are 110 and the voltmeter have a resistance of 15 000 ohms, the test is continued by connecting the voltmeter and insulation of the wire in series with each other. This is done by immersing the coil of wire in a tub of water, its two ends protruding.

One end is connected to the voltmeter, the other pole of the voltmeter to the source of current, and the remaining extremity from the current supply to the water. When a current tries to pass it must pass from the source of current through the voltmeter, through the covering of the wire back to the point of starting. If the voltmeter reads $\frac{1}{2}$ a volt, the resistance of the covering is as follows :

(1) voltmeter = 15,000 ohms
reading = 110 volts.



PORTABLE WHEATSTONE BRIDGE TESTING SET.

(2) voltmeter = 15,000 + unknown ohms
reading = $\frac{1}{2}$ volt.

Therefore

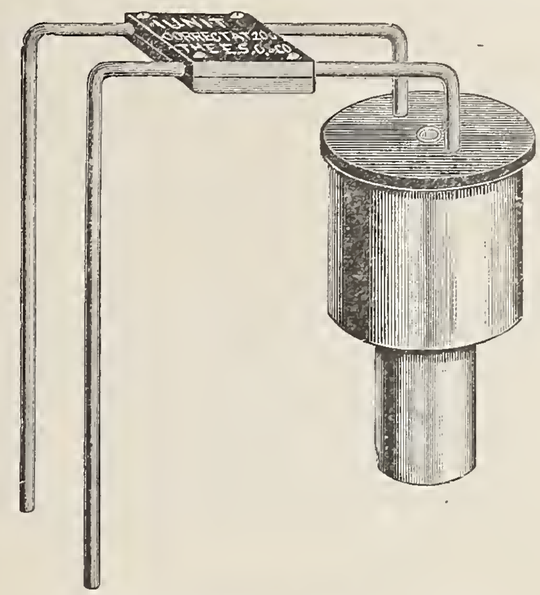
$$15{,}000 + \text{unknown } R : 15\,000 = 110 : \tfrac{1}{2}$$
$$15{,}000 \times 110 = \tfrac{1}{2} \times (15{,}000 + \text{unknown } R)$$
$$= 7{,}500 + \tfrac{1}{2} \text{ unknown } R$$
$$\text{or } \tfrac{1}{2} \text{ unknown } R = 15{,}000 \times 110 - 7{,}500$$
$$\text{“} \quad R = 3\,285{,}000.$$

This answer would be given as 3.28 megohms. The same practice is carried on with a testing set and a galvanometer.

Shunts.—When using galvanometers for such work, a set of shunts are used called

$\frac{1}{9}$ $\frac{1}{99}$ and $\frac{1}{999}$ shunts.

These are employed for the purpose of obtaining a readable deflection where a great pressure is applied to any high resistance. Were it not for these shunts a delicate galvanometer would be ruined by the heavy work thus



STANDARD COPY OF THE B. A. UNIT.

put upon it and the experiment lack success. The above fractions denote the current passing through the galvanometers when they are used, the galvanometer taking $\frac{1}{9}$, $\frac{1}{99}$ or $\frac{1}{999}$ of the current from the circuit as the case may require.

PRINCIPLES OF DYNAMO DESIGN.

BY

Newton Harrison E.E.

(Continued from page 115.)

The usual method is that of rating the cross section of the bar at a certain number of amperes per square inch. By examining a table on the subject it is to be seen that the range of cross sections at different current densities is as follows for copper :

At 4,000 circular mills per ampere	250
" 2,000 " " " "	.500
" 1,000 " " " "	1.000
" 500 " " " "	2,000

Showing the higher the rating per circular mil, the greater the capacity of the conductor.

It will be evident, however, that the friction of the brush will add heat, and, even if the cross section be ample for the current, this friction will develop a dangerous rise of temperature at normal speed.

The friction at the brushes, determined by the material of which they are made; the velocity with which the commutator moves beneath and the current density are, therefore, related in the discussion of this subject. It is well known that, although these be the result of a design perhaps faultless in its perfect relationship, still, sparking at the brushes may entirely destroy the purpose of such design and create a harmful heating.

Generally speaking, a commutator with 2,000 C. M. per ampere will be of sufficient cross section to carry the current. The greater this specific cross section the better prepared that part is to meet abnormal conditions, even though they be of a temporary nature only.

It must not be forgotten that when a commutator becomes worn it gets turned down, and thus experiences a decrease in cross section which may have a deleterious effect at once upon the armature.

Therefore, an extra provision must be made of at least 50 per cent. to meet this contingency. The elements which will tend to give a factor of increase to the cross section absolutely required would be

Friction at brushes,
Possible decrease in size, by turning down,
Sparking.

The friction at the brushes may be subdivided under the further headings :

Friction at brushes: { Material of commutator, Material of brush, Peripheral speed, Pressure at brushes, Area of contact.

Several cases in actual existence today have as their source of trouble a severe heating at the commutator, due to the development of great heat in the bars, which are of sufficient cross section when at rest, but have their capacity cut down by the use of a carbon brush and a greater pressure of contact. It is very necessary to allow for the reduction in size by turning, because wherever there is friction wear ensues, and in this special case it becomes only too quickly evident.

(To be Continued.)

IMPORTANT PATENT DECISION.

Judge Cox, in the United States Circuit Court, has sustained the patents of Luther Steiringer now owned by George Maitland, on the reissue

This patent covers the wiring of fixtures and sliding shells.

PERSONAL.

Mr. Herbert E. Eustis, of the Eastern Electric Cable Company, was in town this week.

Mr. Frank W. Harrington, of Habirshaw wire fame, has just returned from an extensive western trip and reports a first-class business.

Mr. Taylor, of the firm of Cleveland & Taylor, 5 Dey street, is suffering from a painful ailment in one of his knees, and he is obliged to go about on crutches. His many friends sympathize with him, and hope he will soon be around again on his natural leg.

ASSIGNEE'S SALE.

William J. Hammer and John F. Randolph, assignees, will on March 25, at ten A. M., sell at auction without reserve, to close an estate, a lot of brand new, perfect and complete standard arc lamps, for both direct and alternating current circuits, and standard makes of carbons. These goods comprise the balance of the active stock of the Eletric Construction and Supply Company of No. 18 Cortlandt street.

They consist of the various types of the well-known standard "Ward" Arc Lamps. Also Knight Arc Lamps, made and extensively sold by the Electric Construction and Supply Company, together with certain special Ward, Knight and Kinsman Arc Lamps for Railway Circuits, for photo-engraving, and twin and double Carbon Lamps, a complete Dynamo Plant, Switchboard appurtenances, Voltmeters, Ammeters, Switches, etc., New Weston Voltmeter, New Edison Sockets, Lacombe, Fidelity, National, Solar and Lancaster carbons.

The sale will take place at Cushing's Warehouse, corner Hudson and Morris streets, Jersey City, N. J., at the time and on the day mentioned.

A SIMPLE LAW, UNDER WHICH THE DIAMETER OF A STAND-PIPE, AT ANY POINT IN ITS ELEVATION, MAY BE DETERMINED, AS CONDITIONED ON FREE FLOW OF WATER.

BY F. M. F. CAZIN.

The author proposes to first discuss the fundamental conditions surrounding the flow of water in the shortest possible or vertical stand-pipes, because at an elevation above the apertures of ejection the conditions as to flow, or more correctly, as to velocity of flow, and in consequence as to space required for free flow, are the same for all angles at which the stand-pipe may stand to the horizontal.

In such discussion a previous knowledge on the part of the reader of the laws of acceleration of gravity will be assumed.

A cubic metre or a metric ton of water, if falling as a cohesive mass or body, would be subject to the known law of gravitation, which finds one of its clearest expressions in

$$\text{Head} = \frac{(\text{velocity of ultimate flow})^2}{(4 \text{ distances of fall during the first second})} = v^2/2g = v^2/19.6\text{m.}$$

A current, being composed of cohesive parts, is subject to the same law; therefore the natural velocity (in any part of a stand-pipe) of water, falling in unimpeded motion, is as

$$v = \sqrt{H} \,.\, \sqrt{19.6} = \sqrt{H} \,.\, 4.43 \text{ ms.},$$

and the quantity of water ejected at the lower end of the stand-pipe is governed (1.) by the velocity = v, that the movement of water has acquired by its fall from the head, as described by H, and, (2.) by the area or section, = f, of ejected current, the total quantity of water ejected being expressed by the equation $Q = f \,.\, v$.

The value v, for acquired velocity, appears by evolution from the value for head, as

$$v = \sqrt{H} \,.\, 4.43 \text{ ms.}$$

When the section of ejected current is expressed on the basis of a unit of 10 square centimetres, or of 0.001 of a square metre, then the ejection produces for each metre of its velocity a volume of 0.001 of one cubic metre, or one litre of water, weighing one kilogram, each of which produces per metre of head one kilogram-metre of power —the product of weight and distance falling per second.

The transverse section of water-jet = f expressed in the equation $P = (f.\,v).\left(\frac{v^2}{2g}\right)$ and as evolved from diameter in inches for the metric as well as for the foot-pound system, is by $f = d^2 \times \frac{\pi}{4}$, as follows :

Diameter of Nozzle Tip in Inches.	Expressed in the metric system, as relating to a unit of 0.001 of 10 cm.	Expressed in the foot-pound system, as relating to the unit $= \frac{1}{62.421 \text{ lbs.}} = 0.016$ sq. ft $= 2.304378$ sq. inches.
⅛	0.007917922875	0.005325475768
¼	0.031669291500	0 021301903072
⅜	0.071255905875	0.047929281912
½	0.126677166000	0.085207612287
⅝	0.197933071875	0.133136894200
¾	0.285023623500	0 191717127648
⅞	0.387948820875	0.260948312632
1	0.506708664000	0.340829449174
2	2.026834656000	1.363317796590
3	4.560377976000	3.067465042566
4	8.017338624000	5.453271186360
5	12.667716600000	8.520761229350

The maximum volume and weight of water ejected per second is, therefore, correctly expressed in all cases by

$$Q = f \cdot v = f \cdot \sqrt{H} \cdot 4.43 \text{ kilograms},$$

on the condition that the fall or descent of water is absolutely unimpeded, which in reality it never is. Reduction of impediments, or of resistance, brings the quantity ejected nearer to its theoretical maximum value, but never quite up to it.

One of the conditions to unimpeded fall, with the full acceleration of gravity, consists in the absence of resistance to free fall by the air. This resistance takes a double expression; one relates to matter at rest and the other to matter in motion. One, a counterbalancing impediment known as atmospheric pressure, is unavoidable; the other, the result of a dislodging of the medium in inverse direction to motion in a known quantity (of raising a portion of the medium by the fall of matter therein, when such matter is of limited length*), does not apply to a falling stream of water, because it occurs once only and is not continuous.

Another condition to the unimpeded fall, with the full acceleration of gravity, consists in the falling body descending in sufficient space to allow its free fall and its own free adaptation of form to the changing speed of descending.

Without sufficient space the conditions of free fall would not exist, and all the conclusions derived from the laws of gravitation and acceleration would therefore become inapplicable.

This, then, amounts to the condition that a body of water entering a stand-pipe at a given elevation or head must find within pipe sufficient space for free fall, to be subject in its movements to the otherwise immutable laws of nature relating to the fall of matter.

It is not the quantity of water that may possibly enter the stand-pipe at its head which predetermines the quantity flowing, but it is the possibility of ejection under pressure, which determines the quantity flowing, or the volume of the current per second.

The quantity of water ejected under any head is dependent on two conditions, namely:

1. On v, the velocity, resulting from H, the head, or distance of fall, and
2. On f, the transverse section of ejected current, which is measured by the area of the aperture of ejection.

This quantity ejected per second can never be more than

$$Q = f \cdot v = f \sqrt{H} \cdot 4.43 \text{ kilograms}.$$

It therefore appears that the quantity of water ejected, and in consequence the power evolved thereby, is directly proportional to

1. The transverse section, f, of the ejected current;
2. The square root of the head H.

Therefore, under a 100 ms. head from a nozzle with an aperture of ten square centimetres, the quantity of water that can be ejected is as

$$Q = f \cdot \sqrt{H} \cdot 4.43 = 1 \cdot \sqrt{100} \cdot 4.43 = 44.3 \text{ kilog. per sec.}$$

On the basis of these facts it is possible to establish the transverse section of stand-pipes at any elevation, above the level of ejection, required to permit free descent to a current of known volume, in the form that it will naturally assume under the compulsion exercised by the laws of nature.

As velocity of flow decreases as the distance of fall (head) decreases, in order to provide room for the more slowly flowing current (flowing in consequence in a larger transverse section) the pipe section must be increased, since the velocity, v, of current is less.

Therefore, section of stand-pipe and velocity of current, at any given point above the level of ejection, must be inversely proportional. To establish the relative ratio of velocities for different elevations above the level of ejection we have the equation

$$v \div v(1) = \sqrt{2 \cdot g \cdot H} \div \sqrt{2 \cdot g \cdot H(1)} = \sqrt{H} : \sqrt{H(1)},$$

or, velocities of fall vary as the square roots of distance of fall or of head.

If the velocity of ejection is assumed as = 1, then the proportionate velocity at any given elevation above the level of ejection is as $1 / \sqrt{H}$, and hence, taking the section of ejected current, f, as the unit for measuring F, the transverse section of stand-pipe at any given elevation above level of ejection, we have of necessity

$$F = f \cdot \sqrt{H}$$

as the required transverse section of stand-pipe.

In American practice the section, f, of the ejected current is designated by diameter of a circular nozzle-aperture, the same as the section of the stand-pipe is expressed by its diameter.* It is, therefore, opportune to establish the required ratio between these two diameters.

f, the section of nozzle-aperture, when of circular form, is properly expressed by

$$f = d^2 \cdot p/4,$$
$$d = \text{diameter, and } p = \text{periphery.}$$

And the required section of stand-pipe is also properly expressed, in relation to its circular form, by

$$F = f \cdot \sqrt{H} = d(1) \cdot p/4 \cdot \sqrt{H}$$

Designating the desired diameter of F by d(1), we find the proportional values of d and d(1) by

$$d^2 \div d(1)^2 = d^2 \times p/4 \div d(1)^2 \times p/4 \times \sqrt{H}$$

$$\text{and } d(1)^2 = \frac{d^2 \cdot d^2 \cdot p/4 \cdot \sqrt{H}}{d^2 \cdot p/4} = d^2 \cdot \sqrt{H}$$

$$\text{and } d(1) = \sqrt{d^2 \cdot \sqrt{H}} = d \cdot \sqrt[4]{H}$$

This expresses the law, under which the diameter of stand-pipe at any elevation above level of ejection must be determined, as follows:

"When the total section of any current or jet ejected under pressure or head is known, and is indicated by the diameter of a circle that is equal in area to the total section of ejected current, then the diameter of a circular stand-pipe that will afford sufficient space for the descending water must be at all levels or heads above the level of ejection as the diameter of the circle representing the total area of ejection-apertures, multiplied by the fourth root of the elevation of pipe-section above the level of ejection."

This value $d \cdot \sqrt[4]{H}$ represents the area exigency as conditioned on free fall, but in order to bring practical results as near as possible to the theoretical maximum values for velocities and quantities ejected, and in order to provide for the descending body of water, ever changing its form and lessening its transverse section—its own and best lubricator against the pipe-walls—some spare space is required, and in consequence the practical value for F is as indicated by a diameter:

$$d(1) = d \cdot \sqrt[4]{H} \cdot 1.1$$

All these precautions, however, will not bring the velocity as theoretically evolved from head by $v^2/2g$ to the reduced value of v in $Q = f \cdot v$, when determined by quantity of water actually ejected. (See ELECTRICAL AGE of July 13, 1895, page 16, 2d column, and same July 20, 1895, page 36, 2d column.

*The resistance to falling solids in and by air is as $R = f \cdot v \cdot H \cdot 0.00129318$ kilogram-metre per second, the latter coefficient expressing the density of air compared with that of water, and the unit of f being 0.001 of one metre square. (See "Solids Falling in the Medium I and II," Transactions American Institute of Mining Engineers, by the author.)

* See the above table, which gives the area proportionate to such diameter in both the metric and foot-pound system.

DEPARTMENT OF ELEMENTARY EDUCATION.

BY THE EDITOR.

[*Note.—Any one is invited to ask questions on any point that is not made clear in these articles. Suitable explanations will be cheerfully given under the head of "Answers to Inquiries."*]

TROUBLES IN DYNAMOS AND MOTORS, AND THEIR REMEDIES.

(*Continued from Page* 113)

7. "High" or displaced bars should be carefully hammered down into place, using a mallet or a block of wood. Be careful not to bend the bar, or otherwise injure it. After hammering the bars into place, tighten the clamping rings. If this course of action does not remedy the difficulty the troublesome bar may be filed and trimmed down to the general level of the other bars; or it may be ground down to the proper level. High bars cause the brushes to jump and produce sparking, and incidentally singing.

Low bars require the reverse treatment, as far as grinding is concerned. The rest of the commutator must be ground or turned down and bevelled to the true surface. Flat places in the commutator cause vibration of the brushes, with the same accompaniments as above.

8. *Overloading, resulting in too great current in the armature*, is the next cause, in order, to which sparking at the brushes may be attributed.

Overloading may be caused by—

Having too may lamps in circuit, assuming that we are now dealing with incandescent circuits.

By grounding or leak from a short-circuit on the line, or

By a dead short-circuit on the line.

Motors also suffer from excessive current in the armature, due to overload, under the following conditions :

Excessive voltage, if the circuit is of the constant potential class;

Excessive amperage, if the circuit is of the constant current class ;

Friction at the bearings; or,

Too great a load on the pulley.

Remedies.

9. When there are too many lamps on the circuit, the obvious remedy is to reduce the number, and in this way diminish the demand for current.

Where grounds or leaks on the line are the cause, the line should be tested, the cause of the trouble located and the proper repairs effected.

In case there is a dead short-circuit, the safety fuse will likely "blow." Shut down the dynamo, which should not be started again until the cause of the trouble has been remedied. The cause may be found by testing the line and following out the same course of action as above. Do not insert another fuse until the cause of the trouble has been removed, as it would blow out again.

In the case of motors, when the overloading is caused by excessive voltage or excessive amperage, the remedy may be found in using the proper current for the machine, with a proper rheostat or controlling switch. The motor should not be overloaded, but should be kept within the limits of its rating. If the cause of the trouble is due to friction at the bearings, the friction must be reduced. The various causes of friction at the bearings will be considered in connection with heating of bearings.

10. *Faults of the armature* may be caused by—

Short-circuited coil ;

Broken wire in coils or a broken connection, or by a

Cross-connection.

Remedies.

11. Short-circuited coils may be the result of lodgment of copper dust, solder, or other metallic substance between the commutator bars. Any such substance must be carefully removed. See that the clamping rings are well insulated from the bars of the commutator, and free from dirt, metallic dust or any other material that would favor a short circuit. If this does not remove the trouble, test the coils for short-circuits or cross-connection. If the trouble is thus located the armature should be rewound to correct the difficulty. The brush holders should be carefully examined as to their insulation. A slight accumulation of dirt, oil or copper dust may cause a short-circuit from the brush-holder to the rocker-arm.

12. In case of a broken wire or connection, the break may be temporarily bridged over by "staggering" the brushes until the dynamo is shut down. Then test for the trouble and effect the proper repair. This remedy is only a temporary one, and should not be resorted to unless the sparking is bad, and the machine cannot be shut down at once. If the dynamo can be shut down look for a broken or loose connection with the commutator bars. If it is found on test that there is a broken wire inside of a coil, the only remedy is to rewind. A temporary remedy for this trouble is to solder together the commutator lugs of the defective coil, or bridge them across with a piece of heavy wire, thus cutting out the seat of the trouble. In applying this remedy care must be taken that good coils are not accidentally short-circuited.

13. A cross-connection in an armature exhibits practically the same symptoms as does a short-circuit, and requires the same treatment. Each coil should on test show a complete circuit, with no cross-connection with any other coil.

14. Another cause of sparking at the brushes, which was not enumerated at the beginning, is weakness of the magnetic field.

15. *A weak magnetic field* may be caused by—

Broken or short-circuit in the field coils;

Improper winding, or

Insufficiency of iron in the core.

Remedies.

16. Broken or short-circuits in the field coils are remedied only by rewinding. if the seat of the trouble is inside of the coil; if on the outside, easier repairs may be effected. If the trouble is due to improper winding or an insufficient amount of iron, the only remedy is to rebuild the machine.

(*To be Continued.*)

ELECTRIC RAILWAY IN KIOTO, JAPAN.

In a recent issue of The Electrical Age our Japanese correspondent referred briefly to the installation of an electric railway in Kioto, one of the chief cities of Japan. We have just come into possession of further details regarding this road, which will, no doubt, be of interest to our readers.

The line was built by the Thomson-Houston Company, and the current is taken from a central station, which supplies power to a number of silk mills as well as the electric lighting of Kioto. The source of power is a canal from Lake Biwa, which is also used for navigation and irrigation purposes. There are 20 Pelton wheels of about 120 h. p. working 12 dynamos, arrangements being made for the employment of alternating currents of from 1,000 to 2,000 volts, and a three-phase system at 2,000 volts, as well as a 500-volt continuous current, the total output being at present about 1,200 kilowatts. One curious feature is an inclined plane 700 metres long, with a fall of 7 per cent., which is used for transporting barges from the canal to the River Ujigawa, and *vice versâ*. This is worked by a cable driven by a 50-h-p. Thomson-Houston motor. The electric railway is 18 kilometers (11¼ miles) long, and is worked with 26 cars fitted with Thomson motors. It is stated that the results of this railway have been so encouraging that the municipalities of Tokio, Yokohama and Osaka have decided on adopting similar lines.

The maximum number of lines of force which usually traverse a bar of soft, annealed iron one square centimetre in cross section, is about 32,000.

PROTECTING ELECTRIC APPARATUS AGAINST LIGHTNING.*

BY A. JAY WURTS.

The problem of protecting electric apparatus against lightning has not been altogether one of invention ; it has been quite as much one of careful and patient observation. Four years ago it was customary to place a single lightning arrester at the point where protection was desired. Today the same point is protected by distributing line arresters at frequent intervals over the system. This change has resulted partly through the invention of more simple and effective lightning arresters—instruments which can be trusted at a distance from station attendants and which are free from the necessity of occasional inspection; but perhaps more through a more complete understanding of the problem—of the conditions which have to be met.

The most important characteristic of static discharges from electric circuits is that of selection. Discharges do not, as has been commonly supposed, follow the "shortest and easiest path to earth." Were this the case, one arrester carefully installed would be all sufficient. The discharge being selective, it is very certain that one arrester is not sufficient, and further, if line arresters be connected at frequent intervals, the path which will be selected will more and more likely be one of the arresters rather than the apparatus in proportion as the number of arresters is increased. This statement is sustained in practice by the rapidly growing use of line arresters. Station arresters are perhaps advisable as an extra precaution, but in general discharges entering the station offer a fair indication that more lightning arresters are needed on the line.

The question naturally arises : "How many lightning arresters should be connected to a given length of circuit?" The writer recommends four to the mile of wire, but this is by no means to be taken as an invariable rule ; much depends upon the local conditions, the character of the soil with reference to ground connections and liability of lightning to strike, the grade of insulation to be protected, the voltage of the circuit, which latter governs the safe spark gap length which may be employed, and the surroundings with reference to telegraph and telephone wires. In general, thickly settled districts tend to decrease the number of lightning arresters which may be required.

* *Cassier's Magazine* for March.

EEFICIENCY OF INCANDESCENT LAMPS.

The following table of efficiencies of 100 volt 16 candle-power lamps is the result of a test made with some of the prominent makes :

	Amperes.	Watts.	Watts per C. P.
Thomson-Houston	.62	62	3.875
Edison	.55	55	3.437
Buckeye	.56	56	3 500
Packard	.57	57	3.362
Bernstein	.65	65	4 062
Beacon	.54	54	3.375
American	.58	58	3.625
Columbia	.61	61	3.800
Keystone	.56	56	3 500

THE BENEFIT OF SILENCE.

If the effort be not made to clothe thought in proper language, it will be at the expense of the former ; for words not only form "the link between the object and the memory of it," but thoughts unassociated with words very soon die away from the memory. What, then, is the remedy? The cultivation of deliberation and originality, and the *encouragement of occasional silence.* To do this is sometimes difficult, for it implies the mending of long-existing habits, and in some measure the very loss of individuality; for many of us are apt to take refuge in conversation behind phrases and tricks of speech that have served us well in the past. Good listening is conducive to expressive speech, and the words that are formed from violent impressions are not those betokening the exercise of clear thought.—"The Perils of Small Talk," by Allen McLane Hamilton, in the March *Century*.

STANDARD RULES FOR ELECTRICAL CONSTRUCTION.

Editor Electrical Age,

Dear Sir:—On behalf of the committee of Standard Rules for electrical construction and operation of the National Electric Light Association, I write to state that after mature deliberation it has been decided to extend an invitation to the Underwriters' National Electric Association to send a delegate to the joint conference to be held on March the 18 and 19. This Association has been added to the list of eleven organizations already co-operating, which was published in the recent issue of your Journal.

Our Committee was led to this action, which has been under consideration for some time past, by reason of the fact that they felt that while the insurance interests of the country would be ably taken care of by the representative of the National Board of Fire Underwriters, and although they realized that the Underwriters' National Electric Association acting merely in an advisory capacity, being composed of the electrical inspectors from all parts of the United States and having no authority in itself as an association, so closely were they identified with the preparation, endorsement and enforcement of rules for electrical construction and operation, and so alive to the practical questions which would come before the joint conference, that the Committee felt it advisable to extend an invitation to their organization to send an official delegate on the same par with the eleven other interests already invited.

I append herewith a list which has been prepared ot complimentary delegates to be invited to the joint conference in an advisory capacity; but solely as individuals and not as representing any association or manufacturing interests. These gentlemen by reason of their experience, the nature of their occupation, their identification in the past with work such as the proposed joint conference will consider, together with their prominence in electrical engineering matters, have been considered by the Committee as likely to lend valuable advice and additional strength to the joint conference.

LIST OF COMPLIMENTARY DELEGATES.

Wm. MacDevitt, inspector Board of Fire Underwriters, Philadelphia, Pa.

A. E. Kennelly, consulting engineer and expert, New York.

W. J. Jenks, electrical engineer and expert, New York.

A. H. Henderson, chief inspector Fire Department, New York.

Morris W. Mead, superintendent bureau of electricity, Pittsburgh.

Prof. Wm. A. Anthony, consulting engineer.

E. H. Johnson, New York.

S. E. Barton, New York.

E. V. French, inspector factory Mutual Fire Ins. Co., Boston.

The committee has in preparation a transcript of the various codes most extensively in use, and this, in a convenient and compact form, will be in the hands of each delegate prior to the meeting, at which a large amount of additional matter bearing upon American and European practice will be available, and it is the intention that in the consideration of the various rules presented at the joint conference, the decision as to what shall be adopted for the national code will be governed solely by the law of the "survival of the fittest."

Yours very truly,
W. J. Hammer,
Chairman Com. N. E. L. A.

TELEPHONED TO HIS DOG.

A good many stories are told of the strange uses of the long-distance telephone. The day the line was opened to Merrill, Wis., a Chicago man hunting in the Northern woods came into town and learned of the innovation. He went into one of the "sound-proof" booths and had himself put into communication with his family. As they had a telephone at the house the task was a small one. He chatted with his wife, told her a fish story at which she might smile without embarrassing him, since he could not see the sign of incredulity; talked with his boy and girl, and then called for "Gyp."

"Gyp" was a setter, a great family pet, which had been left behind because of an accident which had rendered him lame "Gyp" was called to the telephone, and he stood on a chair, his fore feet on the back, and his mistress held the transmitter to his ear.

"Hello, Gyp!" called the master from Merrill, and the dog in Chicago pricked up his ears and whined. The master then whistled cheerily, and the setter barked directly into the receiver. He knew his master's voice and whistle as well, and the master cheered him by ready laughter at the prompt and eager reply.

It was worth the $2.40 it cost.—*The Tacoma Ledger.*

THE ELECTRICAL EXPOSITION.

In connection with the electrical exposition, to be held in this city next May, arrangements have been made for a very interesting Historical and Loan exhibit, to which it is intended to devote considerable space on the main floor. A committee, composed of T. Commerford Martin, Dr. Park Benjamin and E. L Morse, has been asked to take the superintendence of this exhibit, and, having consented to do so, is already at work. Dr. Benjamin has one of the very finest libraries in the world of early books on electricity, and these will be shown in cases, arranged chronologically with explanatory notes, portraits, autographs, etc. Mr. Morse, as the son of Professor S F. B. Morse, is the possessor of an invaluable collection of telegraphic relics, curios. documents, etc., including his father's note books and sketches, all of which will be shown. Mr. Martin, besides owning many objects of interest connected with the early days of electricity, has secured from Mr. Tesla, Professor Elihu Thomson, Mr. Edison, Mr. Edward Weston, Mr. Stieringer, and others no less well known, the loan of early and interesting apparatus, constituting a personal exhibit from each inventor of the most interesting and instructive nature. It is believed that, judging even from present indications, the historical and loan collection will far surpass anything of the kind ever attempted in this country.

DESTRUCTION OF THE GARVIN MACHINE WORKS.

On March 6, for the second time within six weeks, the Garvin Machine Works, Canal and Laight streets, New York, were visited by fire, disastrous results attending the last outbreak. The 6-story building and its contents were completely ruined, the floors and roof giving way and the heavy machinery and stock of the Garvin Company were deposited in an inextricable mass of ruin into the cellar.

The fire began in an adjoining building and crept into the Garvin works through the belt hole in the wall by which the Garvin Machine Co. supplied power to the adjoining building.

The fire started about 2 A. M., and it was not under control until 6 o'clock.

The company has opened a temporary office at Laight and Canal streets, and is receiving and filling orders as usual. Over 100 men are employed in the temporary quarters, in the old annex, Desbrosses, Vestry and Greenwich streets. The company will erect a new fireproof building, and it will be better adapted for its particular class of work than the old one was. It will be ready by May 1, next.

THE NATIONAL UNDERGROUND CABLE COMPANY.

We learn that the National Underground Cable Company has just received from the Central Union Telegraph Company a very large contract for telephone cable for the city of Toledo, Ohio, the contract covering also the laying, jointing and connecting of the cables, etc.

This is about the largest single telephone cable order given out in the year 1896, and the National Company is to be congratulated upon securing it. This progressive and enterprising company has booked during the week also several large orders for electric light and street-railway cables; and is rapidly making itself felt in the line of telegraph cables, for the manufacture of which it has a special department in its factories at Harrison, N. J.

Telephone Notes.

Carrollton, Ky.—A telephone line will be built from Carrollton to Easterday.

Hastings, N. Y.—The Hastings Village Trustees will consider the application of the Westchester Telephone Co. to put up poles and wires in the village streets.

Chicago, Ill.—Farr Telephone and Construction Supply Co. Capital, $10,000. Incorporators: Kenneth R. Smoot, Clarendon B. Ey e and M. E. Shea.

Wyoming, N. Y.—The people of Wyoming are agitating the formation of a local telephone service.

Augusta, Ga.—The Augusta Telephone & Electric Co. has accepted charter and organized with W. C. Jones, president and P. M. Mulheim, secretary-treasurer, to establish a telephone system.

Cambridge, Md.—The Dorchester Telephone Co. has been organized with G. W. Woolford, president, and T. H. Medford, secretary-treasurer. Capital stock, $1,500; to establish a telephone system.

Cremora, Va.—Newton Patterson and others have organized a company to establish telephone systems.

TELEPHONE PATENTS ISSUED MARCH 3, 1896.

Telephone Call Register. Heinrich Hempel, Berlin, Germany. (No. 555,645.)

Party Telephone Line Apparatus. Angus S. Hibbard, Chicago, Ill. (No. 555,725.)

FOR UPTOWN TELEPHONE SUBSCRIBERS.

An uptown branch of the Contract Department of the Metropolitan Telephone and Telegraph Company has been established at 113 West 38th street (one door from Broadway), where all business relating to the supply of telephone service can be transacted as readily as at the main office at 18 Cortlandt street. There are 14,000 telephone stations in New York City. Metallic Circuit Service, Rapid, Efficient, Permanent can be had from $75 a year.

Possible Contracts.

Cleveland, O.—It is stated that the Baltimore and Ohio is about to expend over $500,000 on the terminals of the Cleveland Terminal and Valley in Cleveland, including a large passenger and freight station.

Spencer, Mass.—The Warren, Brookfield and Spencer Electric Road has been granted a charter for a new electric road, and the Worcester Construction Co. has been awarded contract for building same.

New York City.—Robert and Ogden Goelet will build a four-story brick store and lofts at a cost of $50,000 at 206 to 208 Mercer street.

Sarah J. Wyckoff, 240 West 55th street, will erect a four-story brick store and office at 207 Sixth avenue, at a cost of $25,000.

PITTSBURGH, PA.—The City Savings Bank has made plans for the erection of a new building on the site of the present structure, corner of Smithfield street and Sixth avenue.

HYATTSVILLE, MD.—The Columbia and Maryland Electric Railway has been granted permission to construct tracks through Hyattsville.

MCKEESPORT, PA.—The McKeesport Electric Railway Co. has secured rights of way to extend its line from McKeesport through Riverton, Denmier and Saltsburg to Port Berry. This route will be occupied this spring.

SYRACUSE, N. Y.—Willis B. Burns and Lyman C. Smith, the owners of the Burns Hotel, have decided to remodel the house to the extent of $25,000, the work to begin at an early date. Architect Archimedes Russell is at work on the plans.

BELLOWS FALLS, VT.—The Bellows Falls and Saxtons River Electric Railroad will be built early in the spring. The distance is five miles.

EASTHAMPTON, MASS.—The Mt. Tom Electric Railway will be built this year, if the permission of the legislature for the incorporation of the company can be secured. W. S. Loomis is at the head of the movement.

BUFFALO, N. Y.—The Holland House, 640 Main street, will be torn down and a modern five-story brick business block will be erected in its place by the owners, John Otto & Sons. Plans have been prepared by Architect F. A. Kent.

SCRANTON, PA.—Arthur Frothingham began the excavation for the Arcade on Penn Avenue. He announces that he will erect on this site a seven-story building containing seven stores.

NEW YORK CITY.—The Irving Savings Institution, 96 Warren street, will erect a three-story brick and marble bank building at 115 Chambers street, at a cost of $34,000.

FREELAND, PA.—It is rumored that the Lehigh Traction Co. is endeavoring to obtain control of the Jersey Central branch leading from Eckley to Drifton, with the hope of extending the trolley line to Eckley.

BERKELEY SPRINGS, W. VA.—It is said that eastern capitalists contemplate purchasing the Berkeley Springs Hotel, and expending $500,000 in improvements to same.

BALTIMORE, MD.—The Maryland Traction Co. will build an electric line about six miles long, through Woodberry and other suburbs to Mount Washington.

New Corporations.

SOUTHBRIDGE, MASS.—The Southbridge & Sturbridge Street Railway Co. has been incorporated by Thos. J. Robinson, Geo. W. Wells, Calvin D. Paige, Chas. W. Hill and F. L. Chapin, to build an electric railway. Capital stock, $60.000.

HARRISBURG, PA—The Chester & Marble Electric Railroad Co., of Delaware County, has been incorporated, with Warner H. Jenkins, president; to construct an electric line. Capital stock, $72,000.

KEY WEST, FLA.—The Key West Ocean Telegraph and Telephone Co. Capital stock, $25 000. W. D. Cash, president; B. McLendon, secretary; W. B. Curry, treasurer. To construct telegraph and telephone lines.

KINGSTON, N. Y.—The Kingston and Lake Katrine Co.; to operate a street surface railroad four and a half miles long. Capital, $100,000. Directors: Richard Lenahan, James P. Balch, Wm. J. Turck and others, of Kingston; Dennis A. Kennelly, of New York City, and Herbert W. Martin, of Bennington, Vt.

NEW YORK, N. Y.—Barriet Armature Winding Co. has been incorporated by W. J. Quencer, A. B. Quencer, H. W. Shonnard, New York; to manufacture electrical machinery. Capital stock, $10,000.

MINNEAPOLIS, MINN.—Bicycle Electric Light Co. has been incorporated by W. H. Brown, Aug. Perrault, John Theis. Capital stock, $35,000.

LOUISVILLE, N. Y.—St. Lawrence Power Co. has been incorporated by Michael H. Flaherty, H. H. Warren, Charles A Kellogg, Charles B. Higgins, Albion Mann; to develop and to furnish hydraulic and electrical power, etc. Capital stock, $200,000.

NEW YORK, N. Y.—Fortosec Battery Co. has been incorporated by J. C. Chapin, W. A. Pollock, New York; Chas. H. Shaw, D. N. Maxon, Brooklyn, N. Y., to manufacture electric supplies, etc. Capital stock, $1,000,000.

Trade Notes.

The Manufacturer's Advertising Bureau, 111 Liberty street, New York, is out with the third edition of its pamphlet on "Advertising for Profit—Aid to Advertisers." It is neatly gotten up and full of facts that cannot be controverted.

Messrs. Zimdars & Hunt, electrical contractors, 127 Fifth avenue, New York, have secured the contract for the complete electrical installation on Mr. Borden's new twin-screw yacht now building at the Erie Basin, Brooklyn. This yacht, it is said, will be the largest afloat.

The E. S. Greeley & Co., 5 and 7 Dey street, New York, are having plenty of orders for Crookes' tubes, Geissler tubes and induction coils for X-ray work. This house carries a substantial stock of these apparatus and can fill orders without delay.

Cleveland & Taylor, electrical contractors, 5 Dey street, New York, have closed a contract to install electric lights, electric bells, burglar alarms and gas lighting systems in eight private houses on West 74th Street, Riverside Drive and West 75th street.

ELECTRICAL and STREET RAILWAY PATENTS

Issued March 3, 1896.

555,487. Closed-Conduit Electric Railway. Chris. Anderson, Leeds, England. Filed March 1, 1894. Patented in England July 31, 1893, No. 14,647.

555,488. Closed-Conduit Electric Railway. Chris. Anderson, Leeds, England. Filed February 13, 1895. Patented in England July 13, 1894, No. 13,549.

555,491. District Alarm System. Max E. Barrett, Chicago, Ill., assignor to the Chicago Telephone Company, same place. Filed April 16, 1895.

555,494. Elbow. Orlando P. Briggs, Chicago, Ill., assignor to the Western Electric Company, same place. Filed October 11, 1893.

555,503. Controlling Mechanism for Electric Motors. Lucius T. Gibbs, Milwaukee, Wis. Filed January 2, 1896.

555,509. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa., assignor to the General Electric Company, of New York. Filed June 21, 1894.

555,511. Method of Converting Potential Energy of Carbon into Electrical Energy. William W. Jacques, Newton, Mass. Filed June 5, 1895.

555,528. Adjustable Life and Wheel Guard. Edgar Peckham, Kingston, N. Y. Filed December 24, 1894.

555,529. Motor-Hanger for Electrically Propelled Cars. Edgar Peckham, New York, N. Y. Filed June 11, 1895.

555,544. Dynamo-Electric Machine and Electric Motor. George A. Welles, jr., New York, N. Y., assignor to the C. & C. Electric Company, of New Jersey. Filed April 12, 1895.

555,546. Electromagnet for Separating Metals. Harvey H. Whitacre and Andrew C. Wolfe, Wellsville, O. Filed March 1, 1895.

555,571. Trolley-Pole and Connection. Charles H. Finson, Pittsfield, Me., assignor of one-half to Herbert L Winslow, Brooklyn, N. Y. Filed July 20, 1895.

555,585. Safety Appliance for Electric Brakes. William B. Potter, Schenectady, N. Y., assignor to the General Electric Company, of New York. Filed April 22, 1895.

555,589. Electric Meter. George A. J. Telge, Oldenburg, Germany. Filed February 21, 1895.

555,590. Monocyclic Generator. Elihu Thomson, Swampscott, Mass., assignor to the General Electric Company, of New York. Filed March 29, 1895.

555,601. Electric Railway Signal. Wilhelm Fiedler, Charlottenburg, Germany. Filed August 25, 1894. Patented in Germany February 6, 1894, No. 7,350.

555,621. Electric-Arc Lamp. Rupert Schefbauer, Hoboken, N. J., assignor to the Auerbach-Woolverton Electric Company, same place. Filed August 8, 1895.

555,626. Fac-simile Telegraphy. Alfred W. Storm, Ramsey, N. J., assignor to himself, William D. Stratton, Middletown, and Arthur C. Butts, New York, N.Y. Filed September 11, 1895.

555,628. Armature for Dynamos and Motors. George A. Welles, Jr., New York, N. Y., assignor to the C. & C. Electric Company, of New Jersey. Filed April 12, 1895.

555,634. Trolley-Protector for Firemen. John P. Barrett, Chicago, Ill. Filed December 13, 1895.

555,645. Telephone-Call Register. Henrich Hempel, Berlin, Germany. Filed April 9, 1895.

555,674. Trolley-Head. Warren H. Carr, Bath, Me., assignor of five-eighths to William L. White, Albert H. Shaw and Charles R. Dawnell, same place. Filed October 15, 1895.

555,702. Electrical Measuring-Instrument. Adrian H. Hoyt, Penacook, N. H., assignor to the Whitney Electrical Instrument Company, Saco, Me. Filed June 10, 1895.

555,706. Electric-Arc Lamp. Erwin Lavens, New York, N. Y., assignor to the General Incandescent Arc Light Company, same place. Filed May 23, 1895.

555,707. Signaling-Circuit. Joseph J. O'Connell, Chicago, Ill., assignor to the American Bell Telephone Company, Boston, Mass. Filed December 23, 1895.

555,725. Party-Telephone Line Apparatus. Angus S. Hibbard, Chicago, Ill. Filed September 16, 1895.

555,753. Automatic Life-Guard for Cars. Clara M. Beebe, Elmira, N. Y. Filed August 6, 1895.

555,777. Car-Fender. John Kerrigan, Philadelphia, Pa. Filed January 8, 1896.

555,783. Electric Propulsion System for Cars. George M. Melotte, Marsh, Pa. Filed August 15, 1895.

555,792. Method of and Apparatus for Magnetic Separation. John P. Wetherill, South Bethlehem, Pa. Filed February 10, 1896.

555,793. Separation of Franklinite Ore and Metallurgy thereof. John P. Wetherill, South Bethlehem, Pa. Filed February 10, 1896.

555,794. Magnetic Separator. John P. Wetherill, South Bethlehem, Pa. Filed February 10, 1896.

555,800. Electric-Railway System Andrew J. Beitzel, Boiling Springs, Pa. Filed April 15, 1895.

555,832. Electric Coal-Cutter. Imle E. Storey, Boulder, Colo., assignor to the Storey Electric Drill and Power Co., of Colorado. Filed December 20, 1890.

555,841. Electric-Arc Lamp. Thomas E. Adams, Cleveland, Ohio, assignor to the Adams-Bagnall Electric Company, same place. Filed June 6, 1895.

555,846. Bond or Connector for Electric Railways or other Electric Conductors. Antoine Bournonville and John J. Zimmele, Philadelphia, Pa., assignors to the Technic Electrical Works, of New Jersey. Filed September 20, 1895.

555,850. Core and Coil for Dynamo-Electric Machines. Abe L. Cushman, Concord, N. H., assignor of one-half to Benjamin A. Kimball same place. Filed August 29, 1894. Renewed August 28, 1895.

555,851. Armature for Induction-Motors. Abe L. Cushman, Concord, N. H., assignor of one-half to Benjamin A. Kimball, same place. Filed August 13, 1894. Renewed August 28, 1895.

555,852. Wheel-Guard for Street-Cars. John W. Darley, Jr., Baltimore, Md., assignor of one-half to Michael Holzman, Philip Hamburger and Leon Hamburger, same place. Filed May 7, 1894.

555,862. Electric Railway-Brake. John C. Henry, Westfield, N. J. Filed July 3, 1895.

555,891. Electric-Arc Lamp. Thomas E. Adams, Cleveland, Ohio, assignor to the Adams-Bagnall Electric Company, same place. Filed October 10, 1896.

555,895. Method of and Apparatus for Preparing or Treating Electrical Conductors. Charles E. Carpenter, Bridgeport Conn. Filed Nov. 16, 1893.

555,899. Armature for Induction-Motors. Abe L. Cushman, Concord, N. H. Filed June 24, 1895.

ELECTRICAL AGE

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NEW YORK.

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CONTENTS.

GREETING.

We beg to announce to our friends that the management of The Electrical Age Publishing Company has changed hands. Mr. W. T. Hunt still remains connected with the paper, as president; but, in other respects, the move has brought in a new vice president and editor. Mr. W. T. Hunt is well known to all the trade, being practically a pioneer in the electrical advertising profession. He has been connected in the past with journals that have made their mark, and the paper is honored by his attachment to it. Mr. H. C. Beck, the president of the Vosburgh Mfg. Co., Ltd., of Brooklyn, has assumed the vice-president's position. His energy, business tact and prudence have added an element to the paper which will steer our ship with an unfaltering hand through the tortuous channels of business life. Our new editor's name is probably already familiar to many of our readers. Mr. Newton Harrison, a past contributor to the journal, has been placed in the editor's sanctum. Known to many as a scientific writer, a popular lecturer and an able engineer, we feel that with him our equipment is complete. The laudation of men is legitimate if based upon honorable deeds. We have brought the names of our triple alliance before you, kind friends; let us have your good will. Bound together on a ship that whirls us all through life's abyss let each day's labor be a pleasure—each completed act a step forward. We extend to all our friends a cordial invitation to visit us. Our editorial and publishing rooms are open for inspection. We shall try to make this journal reach every crevice in the earth. To make science popular, and to utilize its medium as the means for successful advertising, shall be our holiest object. With your help we shall embrace success.

GREEK MEETS GREEK.

Unhappy lawyers! Hostilities have ceased between the General Electric and Westinghouse Companies. The battles between nations are not as fierce, nor waged as long, as the bloodless feuds between such mighty concerns. It is strange that the tide of reform, the enlightened spirit of arbitration, should begin with the concrete, the nation itself, before it percolates into the pores of trade or can be transfused into the pulsing blood of commerce. The war of litigation has passed. The fight for the control of ideas—the monopolization of patents is over. Six millions of dollars spent as ammunition. What interpreter of the law has become bloated with the wealth of two such colossi?

PHOTOGRAPHING THE INVISIBLE.

Light often moves on its silent way unseen. Astronomers scanning the heavens with the most minute attention have failed to see myriads of undiscovered worlds—the sparkling glints of countless planets.

The photographic plate has proven more trustworthy than the eye.

Distant nebula and constellations, an inestimable distance away, leave the written proof of their presence on the magic plate.

Photographing the invisible is not a new achievement. It has long since been recognized that the eye is deficient; what it sees is not all that is to be seen. Increase its range and the ethereal disturbances will no longer be typified as Hertzian waves, Roentgen or ultra-violet rays, but as shades and colors of light.

While it is useless to speak of future possibilities in an indefinite manner, still none can help seeing a great undiscovered country before them, with its broad fields and alluring landscapes.

A mine of precious ore is often known to exist by its outcroppings. In the well-trodden paths of science such nuggets are frequently stumbled upon. The new photography has its uses. It is not dependent upon popularity for its existence.

Applied to surgery and to certain departments of analysis its continued future is assured.

Prof. Fernando Sandford, of Stanford University, Cal., has probably touched upon the work whereby Roentgen gained a world-wide fame, as early as 1893.

The article then written we have reproduced with the original photographs.

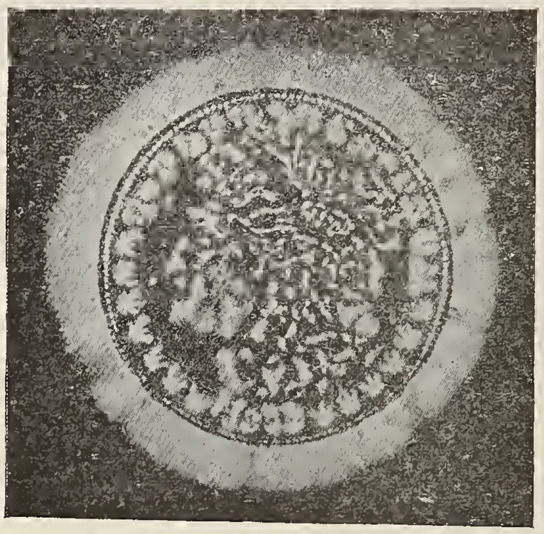
SOME EXPERIMENTS IN ELECTRIC PHOTOGRAPHY.

BY FERNANDO SANFORD.

During the past three years I have been occasionally engaged in some experiments upon electric photography, which may be of interest to the readers of the *Review*, notwithstanding the fact that Professor F. J. Smith, in his recent announcement of his "Inductoscript," has published similar results to those which I have obtained.

In 1891 I developed a negative image upon a piece of bromide paper which had been placed between, and in contact with, two pieces of metal which were connected with the poles of two chromic acid cells. These negatives showed only the places of contact of the sensitized side of the paper and the one piece of metal. During the same year I developed characters written upon a sensitized plate with the end of a wire, the other end of which was connected to one terminal of an induction coil. In September, 1892, I read the article upon Breath Figures, by Mr. W. B. Crofts, in the *Philosophical Magazine* of August, 1892, and it occurred to me at once that these figures might be developed upon a photographic plate. I at once tried the experiment of laying the coin upon the sensitized side of the plate and connecting it with the terminal of a small induction coil, capable of giving a spark of three or four millimeters, while a piece of tinfoil upon the opposite side of the plate was connected with the other terminal of the coil. From the very short notice which I have read of Professor Smith's Inductoscript, this is exactly the method which he is now using, except that he uses a higher potential and exposes the plate only a second, while I exposed the negatives which I made from half an hour to an hour.

Several negatives were made in this way, the accompanying photograph, No. 1, being from one of them. With one exception they all show a fringe around them, due to



NO. 1.

the escape of the charge from the edge of the coin, which accounts for the formation of the dark ring observed around the breath figures made upon glass.

Last September I undertook to photograph in the same way objects insulated from the photographic plate, and have since made negatives of coins separated from the plate by paraffine, shellac, mica and gutta-percha. The accompanying photograph, No. 2, was made on October 7, the coin being insulated from the photographic plate by a sheet of mica about 0.04 mm. thick. The mica was laid directly upon the film side of the plate, and the coin was placed upon it and connected to one terminal of the small induction coil already mentioned. A circular piece of tinfoil of the circumference of the coin was placed upon the glass side of the plate directly opposite the coin, and was connected to the other terminal of the induction coil. The little condenser thus made was clamped between two boards, and was covered up in a dark room. Two small discharging knobs were also attached to the terminals of the induction coil, and were separated by a space of less than a millimeter, so that when a single cell was connected with the primary coil the spark between the knobs seemed continuous.

The plate was exposed to the action of the waves set up in this condenser for one hour, when it was taken out and the negative image developed upon it by the usual process. This photograph was made before I had heard of Professor Smith's process.

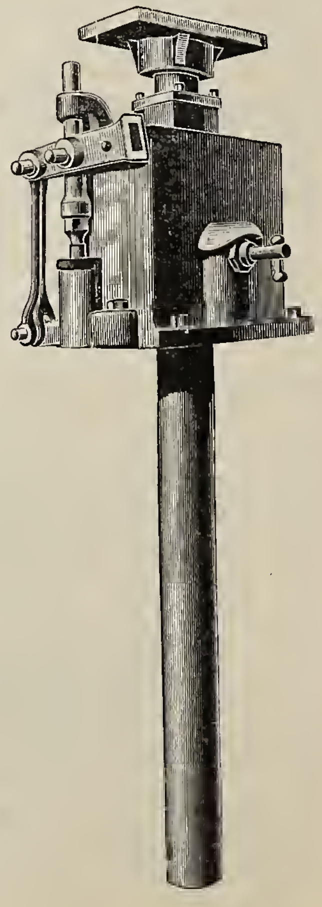
Several interesting facts are shown by these photographs, and it has seemed to me that the process might furnish a

NO. 2.

valuable method of studying some of the phenomena of condensers. The fact that the electric waves sent off by the condenser plates are propagated in a direction perpendicular to the plane of emergence is plainly shown by some of the negatives in my possession. The tendency for the charge to escape from the surfaces of greatest curvature is plainly shown, as in photograph No. 1. The surface of a coin which had been stamped with fine parallel lines gave no image upon the plate, on account of the dispersion of the waves from its surface. In the case of a medal with a head of Washington in high relief, the whole head was left blank, but was outlined by a fringe like that around the edge of photograph No. 1.

I did not succeed in making a good negative through a thickness of insulator as great as one millimeter, but blackened spots of the size of the coin were made through several millimeters of gutta-percha, even with the low potential mentioned above. Unquestionably, with a greater sparking distance, the effect could be observed throughout a condenser of much greater thickness.

ELECTRIC MOTOR LIFT.



In electric railway service, easy means of removing motors from cars is of the utmost importance.

The motor lift shown in the accompanying illustration has been recently introduced by the W. & S. Hydraulic Machinery Works, Watson & Stillman, proprietors, 204–210 East 43d street, New York City.

This instrument is designed to lower the motors from underneath the cars and, when the car is out of the way, raise it to the floor level again. It is a modification of Watson & Stillman's Vreeland Patent Transfer Pit-Jack, and has a single plunger pump with power of four tons and a movement of three feet. It is reliable and easily operated, and is indispensable to any complete electric railroad plant.

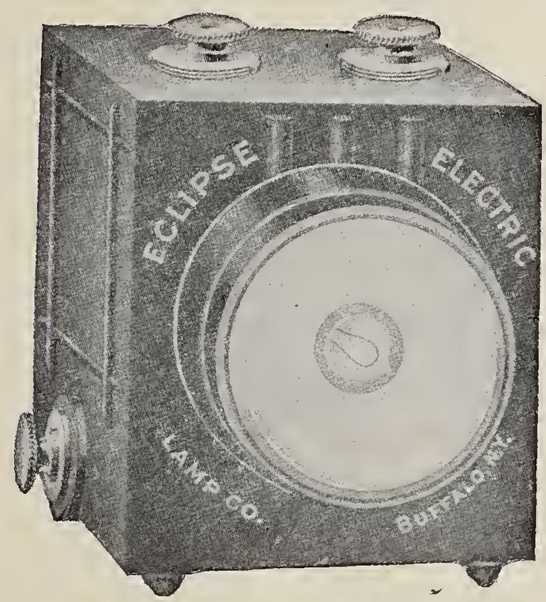
A small four-wheel truck rests on the head of the ram, which enables the motor to be rolled off on the floor to any part of the shop.

The lift is also mounted on wheels, when it is desired to use the tool in a long pit.

PORTABLE ELECTRIC LAMP.

There is a great demand for a portable electric lamp. Such a lamp, to be acceptable and satisfactory to the public, should be compact, small, light, simple in construction, easily operated and not liable to get out of order. It should, besides, furnish a good, strong light, and burn under any and all conditions, and should be as cheap to maintain as an oil lamp.

The lamp illustrated herewith, which is made by the Eclipse Electric Lamp Co., Buffalo, N. Y., is said to fulfil



NO. 3 PORTABLE EIFCTRIC LAMP.

all of these important requirements. It is the result of many years of labor and expensive experimental work and is perfect in every detail It is adapted especially for bicycles, carriages. wagons, or wherever a portable light is required, and can be operated as well by a young boy or girl as by an older person. It throws a strong, brilliant light 75 to 100 feet, and is not affected by wind, rain or jolting; in short, it is the *ne plus ultra* in carriage and bicycle lamps.

Eclipse lamps for portable work are made in two sizes

CHARGING BATTERY WITH ECLIPSE ELECTRIC SAND.

—No. 2 and No. 3. The No. 2 size is made especially for bicycles. It is 3½ inches wide, three inches deep, four inches high and weighs 16 ounces.

The No. 3 lamp is designed for carriages, wagons, miners, watchmen and for general use wherever a portable lamp is desired. Its dimensions are 4½ inches wide, 3½ inches deep, five inches high; weight, 26 ounces.

The batteries are charged with "Eclipse electric sand," which comes in tin boxes, each box containing one charge. The operation of charging a lamp is exceedingly simple. The renewal of zincs is likewise very easily done, and altogether the Eclipse lamp is one of the most satisfactory ever presented to the trade.

MEASUREMENT OF CAPACITY.

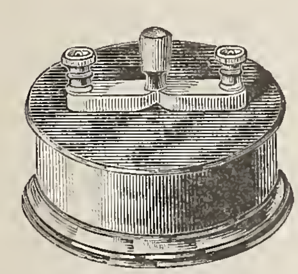
LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

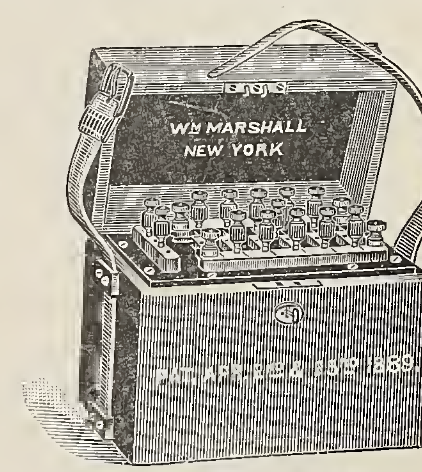
One of the most curious phenomenon is that of the charge and discharge of a Leyden jar. Under certain conditions a body, especially if it be made of metal, possesses the power of absorbing a charge of electricity. The quantity of electricity it retains in any given case is entirely dependent upon the surroundings. An ordinary sphere of brass exercises an inductive effect upon all objects around it. When the adjacent objects are placed in nearer proximity, the ability of the brass sphere to absorb a greater charge increases.

A Leyden jar is simply a pair of metallic plates separated from each other by an insulating material of either air, glass, ebonite or their equivalent.

Without referring, at present, to the insulating material, let attention be called to the conditions which determine



LABORATORY CONDENSER.



PORTABLE CONDENSER

the amount of charge a condenser or Leyden jar is capable of receiving.

From a simple review of the situation it seems more than likely that the capacity of a body to receive a charge of electricity would depend upon certain geometrical as well as electrical conditions.

The question of importance, therefore, is one that brings them into prominence.

The larger a body is, the greater its area, the more competent it becomes to accumulate a great charge. And furthermore, not only, as previously remarked, will its nearness to another conducting body accentuate this property, but the fact that if the air were replaced by some other material it is more than likely that the effect would be further increased and the charge aggravated.

Thus from a glance so brief it is seen that the

Size,
Distance,
and Insulator

have a very noticeable effect upon the charge a body can accrete and hold.

A comparison can very aptly be made between a condenser and a room.

The amount of air a room can hold depends upon its size and the pressure at which the air is driven in. The number of cubic inches of air are therefore solely determined by this. In speaking of the capacity of a room the number of cubic feet would designate this idea, but the geometrical conditions, the very dimensions are thus referred to. A condenser has no fixed capacity. It may be compared with another condenser by charging both with the same pressure, but otherwise the comparison fails.

The meaning of capacity when a condenser is considered is spoken of in Farads.

Unfortunately, a Farad is so large a unit that it could not be considered in a practical sense. The unit used in daily practice is the microfarad, the one-millionth part of a farad.

The quantity of electricity is spoken of in coulombs.

The number of coulombs or the amount of charge a body is capable of receiving, taking the past facts also into consideration, is dependent upon two factors—

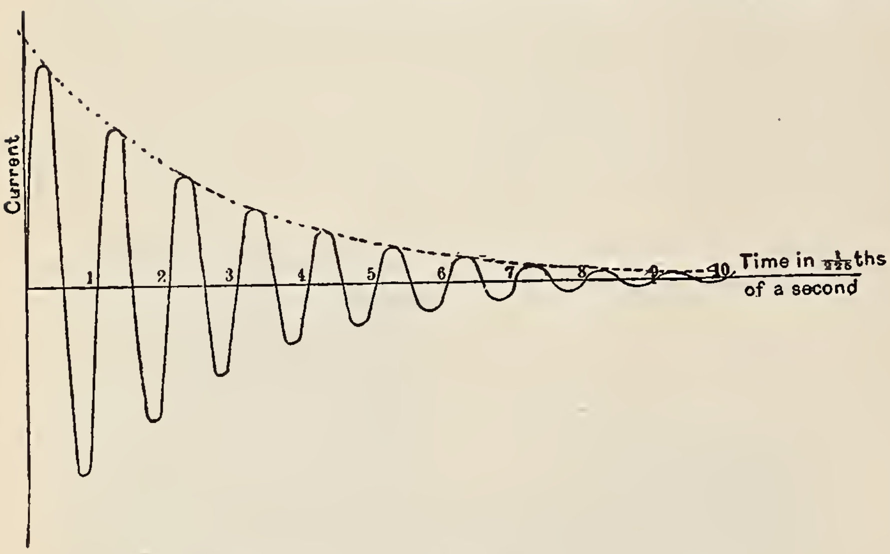
The capacity of the condenser and the pressure. The amount of air in a room or closed tank would depend upon the size of either and the pressure applied; likewise a condenser.

The rule, therefore, illustrating these facts is as follows:

$$\text{Charge} = \text{Pressure} \times \text{Capacity},$$
$$Q = E \times F.$$

where Q = Coulombs,
E = Electromotive force,
F = Farads capacity.

It must be understood that the area of the plates, the



OSCILLALORY DISCHARGE FROM A CONDENSER.

distance between them, and *the nature of the material separating them*, will directly affect the capacity in all cases.

Definition of Capacity.—The capacity of a condenser is determined by the number of coulombs which will raise its pressure to one volt.

A Farad is the capacity of a body which is raised to one volt pressure by a charge of one coulomb.

Specific inductive capacity is an expression defining the extent to which an insulator will allow a charge to affect another body by induction.

It may be understood that air, glass, hard rubber, etc., retard the inductive effect of one body upon another to different extents.

Air is usually referred to as a standard, the induction occurring through it being very slight; the others are rated accordingly.

Specific Inductive Capacity.

Air	1
Rubber	2.3
Paraffine	2 3
Gutta-Percha	2.5
Mica	6.6
Glass	10.0

Glass and insulators made of materials likely to vary in quantity have a spec. induc. capac. dependent upon their purity. The power of glass changes with the amount of lead, etc., it contains.

Condensers in series.—When a set of condensers of equal capacity are connected in series the capacity of the group is reduced, but the pressure increased.

With capacities equal.—When the condensers are of equal capacity, the capacity of all connected in series is equal to the capacity of one divided by the number.

With capacities unequal.—When the condensers have different capacities and are connected in series, *the capacity of the whole is equal to the reciprocal of the sum of the reciprocals.*

Represented in symbols

$$K = \frac{1}{\frac{1}{K_1} + \frac{1}{K_2} + \frac{1}{K_3}} \text{ etc},$$

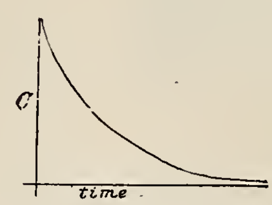
where K = total capacity
K_1 = capacity of first condenser
K_2 = " " second "
K_3 = " " third "

Condensers in Parallel.—When condensers are connected in parallel, *the entire capacity is equal to the sum of the capacities.*

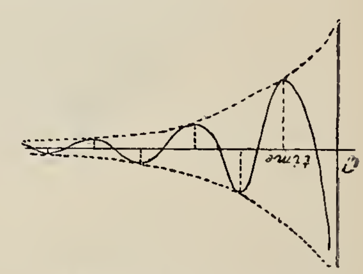
Method of Direct Deflection.—The capacity of a condenser can be ascertained by reference to another condenser in a very simple manner.

In order that two charges may be compared, a galvanometer must be used whose deflection depends upon the amount of the charge sent through it.

A ballistic galvanometer serves this purpose to perfection.



DISCHARGE THROUGH A HIGH RESISTANCE.



DISCHARGE THROUGH A LOW RESISTANCE.

It does not differ in principle essentially from a reflecting galvanometer, except in regard to its swing.

It swings very slowly when subjected to a sudden discharge from a condenser.

Method.—If two condensers of unequal capacity are to be compared, one must be known.

Instead of a condenser, the other may be a section of submarine cable, etc.

Both are charged by a constant E. M. F.—a standard cell, for instance.

When the condenser of known capacity is charged, it is discharged through the galvanometer and the deflection noted.

The other conductor or condenser of unknown capacity is likewise connected and discharged through the galvanometer. The charges are compared by means of the deflections, and the capacities correspond likewise.

Supposing a condenser of one-half a microfarad is charged by a standard Clark cell, when discharged the deflection

$$d_1 = 80;$$

with the condenser to be measured the deflection

$$d_2 = 200$$

The rule states as follows: Capacity of the first: capacity of the second = first deflec.: second deflec.

In symbols

$$F_1 : F_2 = d_1 : d_2$$

F_1 = capacity of first condenser = $\frac{1}{2}$ M. F.
F_2 = " to be determined.
d_1 = deflection due to $\frac{1}{2}$ M. F.
d_2 = " " " unknown capac.;

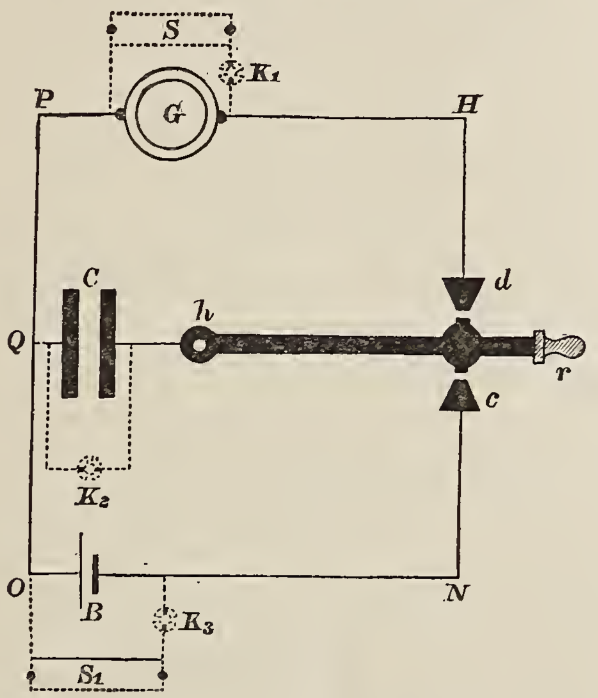
therefore,

$$F_2 = F_1 \times \frac{d_2}{d_1}$$

$$= \frac{1}{2} \times \frac{200}{80}$$

$$= 1.25 \text{ micro-farads.}$$

Condensers are generally made of alternate layers of tinfoil and mica, or tinfoil and paraffined paper.



MEASUREMENT OF CAPACITY BY BALLISTIC GALVANOMETER.

A knot of cable about $1\frac{1}{6}$ miles equals $\frac{1}{3}$ micro-farad capacity.

A condenser in many respects resembles a battery of very high internal resistance.

It has been discovered that condensers when exposed to a rapidly alternating electric current become heated. The paper if paraffined may dissolve the wax. This effect is due to *dielectric hysteresis.*

If the capacity of the great Atlantic cable could be reduced the passage of signals would be greatly accelerated.

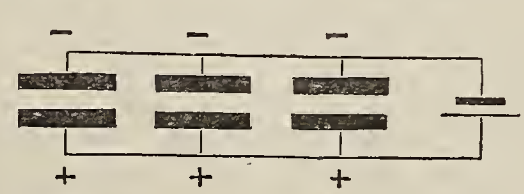


Fig. 181.—CONDENSERS IN MULTIPLE ARC.

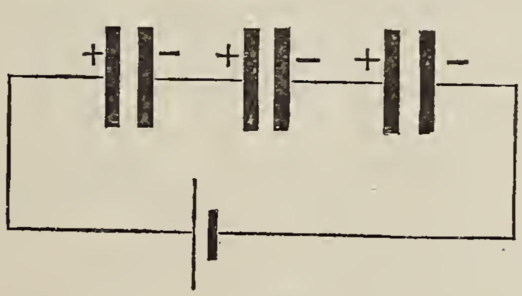


Fig. 182.—CONDENSERS IN SERIES.

At present the cable must first be charged before a signal reaches the other end.

When alternating or interrupted currents are used a condenser prevents rapid communication; a coil of wire, if properly arranged in circuit, will in such a case neutralize its effect.

There being no practical limit to the capacity of a body, the greater the pressure the greater the charge it will hold. In telephone practice the wire is surrounded by crinkled paper, and the insulation over that, to surround it with air if possible—air having a spec. induc. capacity equal to unity—thus reducing the induction and consequent charge.

ROENTGEN RAYS.

Light is produced by a disturbance in the ether. The oscillations causing light range from 400 to 700 million millions per second.

It would be represented in numbers by the quantity 5×10^{14}. To our minds the rate is practically infinite.

A great genius named Maxwell originated the electro-magnetic theory of light. According to his opinions *good conducting* bodies should be opaque, and *good insulators* transparent.

Ebonite is very transparent to long waves of dark heat. It is also transparent to those produced by electrical oscillations—but it is opaque to the shorter ones of light.

The more perfect conductor a metal is, the more opaque it should be in even the thinnest films.

When copper is cooled to such an extent that nitrogen gas would solidify, it becomes a nine-times better conductor than before. Such intense cold is appalling. It is about 328 degrees below zero, Fahr.

Metals contract when cooled. If a film of copper were subjected to cold of—328° Fahr., it would naturally be more dense and, probably, instead of being translucent become entirely opaque.

Tinfoil is opaque to electrical oscillations of one hundred millions per second.

Gold leaf can not be obtained thin enough to allow oscillations of one hundred millions per second to pass through—it seems to be opaque to them at any thickness.

Electrolytes, as a rule, are transparent to light. They should be insulators, according to Maxwell. When the current reverses 1,000 million million times a second they do act as perfect non-conductors, thus justifying the statement.

The time required for electrolytic conduction is but an instant. To show that it is really instantaneous it is not greater than one-hundred-millionth, or less than one thousand-billionth of a second.

INQUIRY COLUMN.

In this column we shall endeavor to answer all questions relating to the science of electricity that may arise in the minds of our subscribers.

(1.) What weight should the best horse-shoe electric magnet sustain when actuated by a No. 2 Samson battery in the best working condition?

(2.) How many lines of force would pass through the magnet when sustaining the weight? J. A. NEILSON,
San Francisco, Cal.

A cell of the above description should energize a magnet properly proportioned sufficiently to hold a weight of at least 20 lbs.

The lifting power of any magnet depends upon the degree of magnetization and the area of contact.

The number of lines of force passing through the iron are 50,000, when its cross-section equals one square inch.

What causes the segments to eat away, although the brushes do not spark?

Alternate segments are only affected in this manner.
C. W. KURTZ,
Confluence, Pa.

If segments do not heat, no power is being wasted there, and the pitting away cannot be attributed to other than a mechanical cause from the information given.

There is a possibility that the entire armature load is being carried by one-half the segments. This theory would be supported by the fact that the rheostat controlling the field got hot. The field may take too much current in order to keep the armature pressure. Examine the armature carefully and see whether alternate coils are not heated, and let us know whether the field coil are not heated, and let us know whether the field coils are hot. If there are no signs of heat anywhere, the trouble is not likely to be electrical.

PRINCIPLES OF DYNAMO DESIGN.

BY

Newton Harrison E.E.

(*Continued from page 126.*)

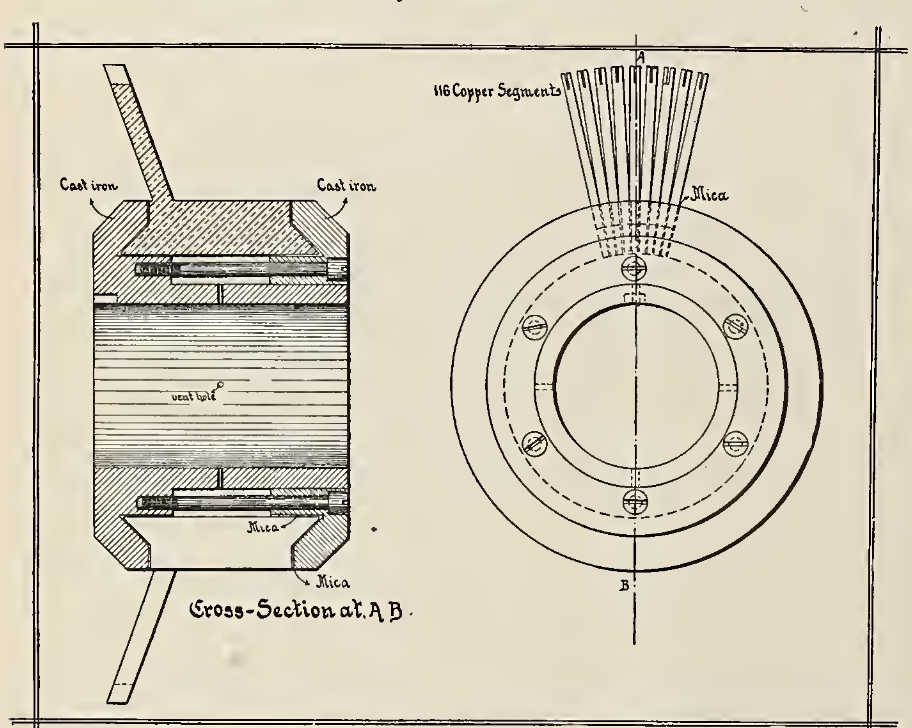
The allowance for high speeds to be adjudged by the peripheral speed of commutator should be, allowing the following percentages :

	For cross-section,	2,000	C. M.	per amp.
20 per cent.	" friction,	400	"	"
50 "	" turning,	1,000	"	"
	Total,	3,400	C. M.	per amp.

Were sparking but casually considered the figures would reach at least 4,000 C. M. per ampere. Yet as such would express either poor design, against which the only protection is complete renovation or overload, the circumstances are of so extenuating a nature as to be swept aside from the present considerations because, in the above, ample provision has been made for practical working limits by the allowed safety factors.

The heat of a burning coil may communicate itself throughout the armature and possibly cause destruction to the other coils, besides unsoldering the commutator connections, unless some practical leeway is allowed for so frequent an occurrence.

The pitting and grooving of commutators is due to neglect as a probable cause more than anything else. Sparking is primarily the cause, yet its worst demonstrations may be quelled and very often obliterated by a change in brush and pressure and a slight shifting of the rocker-arm, as the circumstances may demand.



WORKING DRAWING OF COMMUTATOR.

The design of several types of commutators, using as an insulator mica sheets, are noticeable for their compactness and perfect insulation. The wedge-shaped bars are generally supplied by a firm or foundry making a specialty of such things, and in general the material often employed is phosphor bronze or tempered copper. Castings may be used for very heavy segments, but the majority are drop-forged and require but a slight finishing before being assembled around the body or shell of the commutator. Whether cast or drop-forged, the general practice calls for a thickness of insulation between segments that should not be less than $\frac{1}{32}$ of an inch, and as great as the difference in pressure between bars would require. It is from $\frac{1}{16}$ to $\frac{1}{8}$ of an inch with voltages varying from 110 to 220 volts and may, if the number of bars to the commutator be very large, be considerably decreased. For 110-volt commutators the insulation is called upon to separate bars whose difference of potential is from one to six volts. The fact that the bars may be two in multiple or even three in multiple would be dependent upon the arrangement of the armature winding ; yet the pressure at which an arc starts should never be approached unless with a means of preventing what would otherwise be destructive sparking.

Precautions must therefore be taken when designing the winding that the pressure be subdivided as much as possible between the bars, otherwise a corroding action will inevitably occur on the commutator surface.

Brushes.—The general precautions necessary for the choice of an efficient brush would be its current capacity, its frictional coefficient and its elasticity in many cases where the carbon brush is not used. The bearing surface upon the commutator having but an imperfect contact with the passing segments is to be of sufficient size in square inches to carry the current on an estimated basis of about 200 amperes per square inch of brush surface with copper brushes. With carbon brushes, however, the rate naturally falls, because of the higher resistance of this material, and 100 amperes per square inch would be a fairly good value for these conditions.

The array of brushes on the market are placed in their different categories by manufacturers because of the fact that certain irregularities of design in the dynamo demand a special brush — the dynamo sparking or heating at the commutator due to some inherent fault. With a properly designed machine and a well proportioned commutator, sparking would not be visible nor heat develop with any brush of ordinary value. No ineradicable fault would mean no required attempt to remove it. Therefore the classes of brushes—the copper gauze, copper wire, copper sheet, composition, carbon are all of general value to the good dynamo, but of special and individual value to the dynamo with faults.

The carbon and gauze brushes lead in the opinion of engineers today. The great current carrying capacity of the gauze brush with its elasticity renders it of first value to machines with commutators of a size too small to support the friction and heat of a carbon brush.

A carbon brush has a peculiar advantage over others in reducing sparking. The use of such brushes, employing the method of forced commutation, is now in vogue. Its resistance increasing to a high point when the segment is about to leave it, and the tip of the brush resting upon its edge, has a great effect upon the machine in reducing what at times would be dangerous sparking.

The additional bearing surface required being at least twice that of copper, with a greater pressure to insure contact naturally means greater friction, and without the precaution spoken of—a sufficiently great cross-section in segment to make up for the increased friction—heating is practically inevitable.

A carbon brush with a plunger brush-holder is in common use today for nearly all improved types of machines. The metal of the brush-holder should fit as tightly as is consistent with the free action of the brush, and the spring must be capable of regulation so as to prevent unnecessary pressure.

A carbon block that is fine-grained and has been soaked in oil will be self-lubricating, and will prove a most satisfactory brush to the builder. They wear for months and excel all other kinds in cheapness and excellence.

Gauze brushes will relieve an overcrowded commutator and carry without heat what other brushes could not stand. For heavy currents, where size is an important factor, a small gauze brush will prove of great service.

In the construction of platers where very heavy currents tend to increase the size of the commutator and necessitate the use of a large brush, gauze brushes stand pre-eminent ; other types of brush are of but secondary importance and may be used with indifference provided the design of the machine is not inefficient.

The coefficient of friction is an important factor in determining the smooth running of a machine, and a brush made of an alloy of metals seems to have made for itself an important position in the opinion of engineers. The question apparently assumes this appearance: Shall the brush wear away or the commutator? By experiment the efficacy of a metal when so tested can be quickly determined and, should its conductivity and flexibility be such as to render it competent to meet the conditions of practice, a brush of the above nature would undoubtedly be of great importance to those favoring the metal brush in all cases.

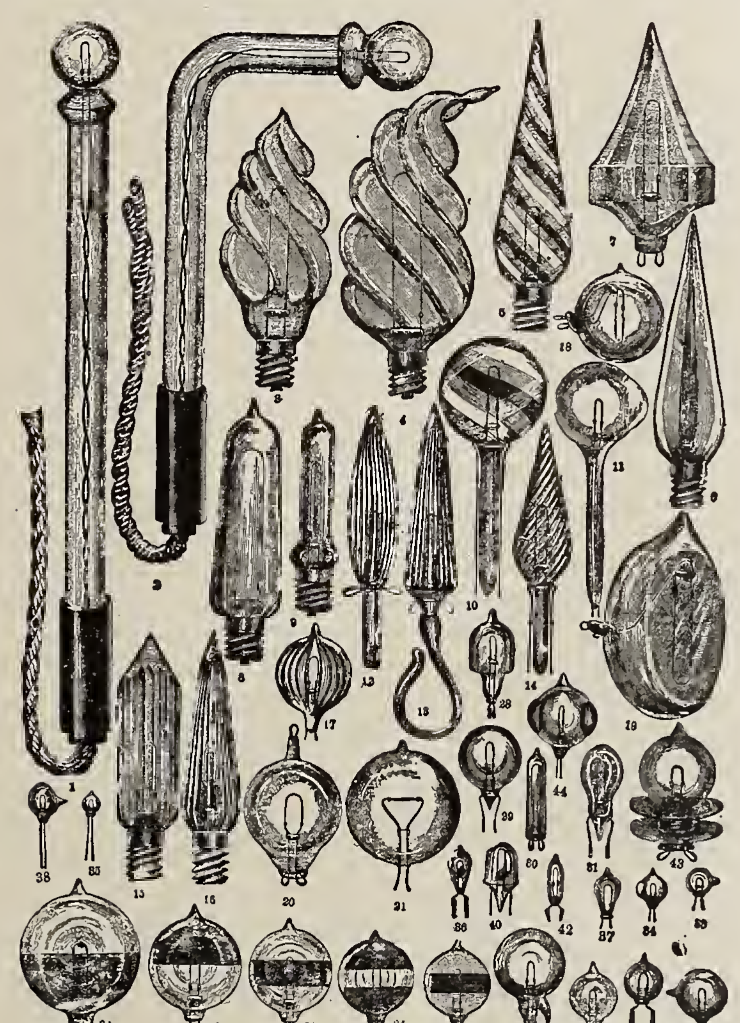
The commutator is usually a revolving conductor; the brush a stationary conductor; to make these two meet with all conditions without rapid destruction to either should be the object of every competent designer.

(*To be Continued.*)

THE STANDARD ELECTRIC LAMP AND NOVELTY CO.

This company has just been organized in this city for the manufacture of miniature and decorative lamps, and electrical novelties. The company's factory and headquarters have been established at 248 West 23d street, New York, where they will have every facility and the best skill for the production of the classes of goods mentioned. The factory will be under the charge of Mr. J. L. Somoff, well-known in the trade as a skilful chemist and electrician. Mr. Charles L. Fowler is president; Wm. R. Powell, treasurer; Harry M. Phillips, secretary.

As the company is backed by plenty of capital the success of the new enterprise is assured.

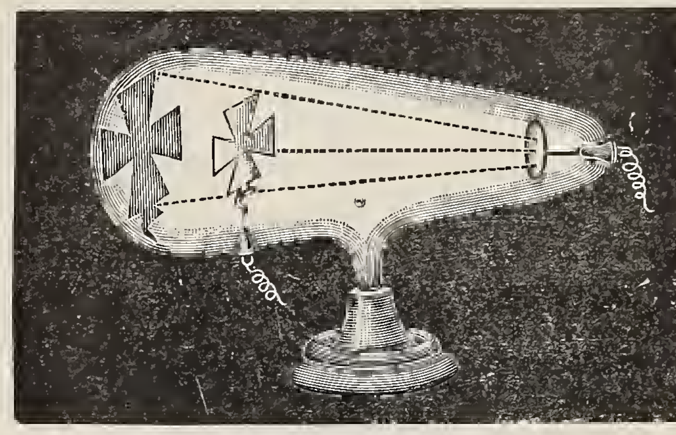


MINIATURE AND DECORATIVE LAMPS.

There is constantly growing demand for X-ray or Röntgen ray lamps or Crookes' tubes and decorative lamps. The ease with which electric lighting effects can be produced for decorative purposes is attracting the attention of the general public, and the demand for the means to accomplish these results grows proportionately. Such decorations are desirable in such places as ball rooms, at banquets, receptions, in the decorations of Christmas trees, at church festivals, at weddings, etc., etc., and the light given by these little beautiful lamps is incomparable in softness and brilliancy by any other form of light.

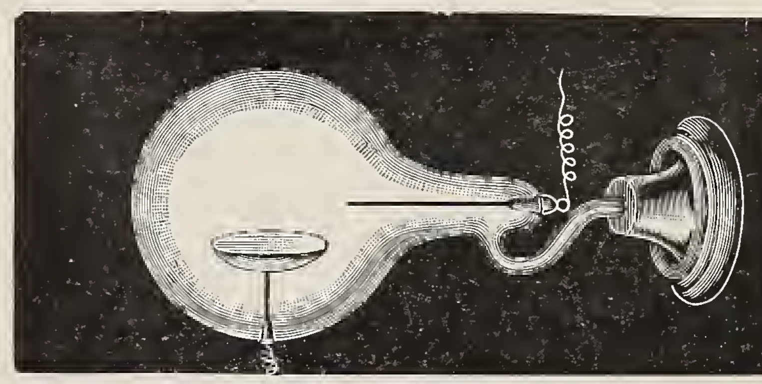
The new company will manufacture lamps for all purposes for which miniature and decorative lamps are adapted, and will make them in all shapes and colors for incandescent or battery currents.

They will also make lamps in a large variety for scientific purposes. Specially made lamps are used for diagnos-



CROOKES TUBE.

ticating diseases, in examining internal cavities of the body, the throat, larynx, etc. The lamps used in this work are antiseptic; they are easily disinfected. They are made of different forms, according to use.



TUBE FOR CATHODE RAYS.

Surgeon's head lamps, cystoscope lamps, lamps for producing brilliant stage effects, etc., etc., may be mentioned as among some of the novelties that the new company will manufacture.

ELECTRIC AND MAGNETIC TELEPHONE TRANSMITTER.

A private exhibition was given in this city to the representatives of the electric press, on March 10, of the Russell Electric and Magnetic Telephone transmitter. For the purpose of demonstrating the power and range of this instrument wires were strung between two distant rooms, and the instruments were put to the test. This instrument is for long or short distances and gives a loud, clear and distinct enunciation. It reproduces a whisper or a shout, and may be so regulated as to increase or diminsh the noise or sounds at will without changing the tones. It can be used with or without a battery, and from a carbon to a magnetic transmitter by simply reversing the instrument, which has two mouth-pieces.

The transmitter will receive sounds uttered and made 25 to 50 feet away, and it will reproduce sounds so that they can be heard as far.

The invention is controlled by the Russell Electro-Magnetic Telephone Company, New York City, N. Y.

The test was in every way entirely satisfactory.

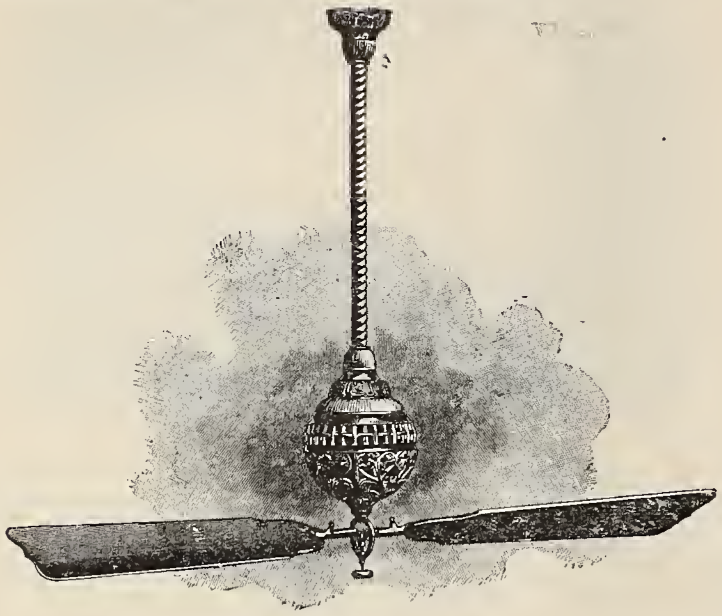
ALTERNATING CURRENT CEILING FAN.

The Tuerk alternating current ceiling fan, illustrated herewith, has many points of excellence that commend the outfit to users of these useful machines.

The fan has neither brushes nor commutator, and the bearings are self-oiling. The blades, which are made of magnolia, may be adjusted to any angle without stopping or changing the speed.

These fans are finished in bronze, nickel, polished brass and bower barff, and are of handsome design. They are slow speed and practical in every detail.

E. B. Latham & Co., 136 Liberty street, New York, are the sole selling agents for these excellent fans.



TUERK CEILING FAN.

ALL OVER.

The following extract from the N. Y. *Sun* touches upon a matter of deepest interest to the trade :

"Negotiations between the General Electric Company and the Westinghouse Electric and Manufacturing Company have resulted in an arrangement with respect to a joint use of the patents of the two companies, subject to existing licenses, on terms which are considered mutually advantageous.

"It has been agreed that after certain exclusions the General Electric Company has contributed 62½ per cent. and the Westinghouse Electric and Manufacturing Company 37½ per cent. in value of the combined patents, and each company is licensed to use the patents of the other company, except as to the matters excluded, each paying a royalty for any use of the combined patents in excess of the value of its contribution to the patents.

"The patents are to be managed by a Board of Control consisting of five members, two appointed by each company and a fifth selected by the four so appointed. Both companies have acquired during their existence a large number of valuable patents, and numerous suits have been instituted in consequence of the infringement of these patents by one party or the other, or by their customers. In the prosecution of these suits large sums of money have been expended and the general expenses of the companies have in this manner been greatly increased. It is expected that the economies to be effected will be very considerable, and that the two companies and their customers will be mutually protected.

"The special incentives which led to the arrangement at this time were the recent decisions in favor of patents of the General Electric Company controlling the overhead system of electric railways, the approaching trials on a number of other important General Electric patents on controllers and details of electric railway apparatus and systems and other electrical devices, and the equally strong position of the Westinghouse Company in respect to power transmission, covered by the patents of Nikola Tesla, and in view of its other patents in active litigation, some of which are of controlling importance."

Safety Rules.—It is stated that the Japanese Electrical Association has asked the Government to issue regulations regarding electric light and power, and offered its services in preparing such a set of rules.

"*Electrical Doings*" is the name of a new paper to be issued shortly by J. P. Madden, 15 Cortlandt street, New York.

THE STATE AND PRIVATE PROPERTY.

BY GEORGE A. NALL, L L. B.

The title, "The State and Private Property," barely explains itself. The relation of that body politic—the state—to the individuals composing it, and the relation of those individuals to the body politic, is a subject too broad and extensive to be considered comprehensively within the limits of this discourse. That a state has a right to use and dispose of an individual's private property has been conceded from the earliest times. Also it has been upheld that there are circumstances in which the individual has a right to be unmolested by the state in the enjoyment of that which he possesses as private property.

The fundamental principle of all law and government is the protection and preservation of certain natural and inalienable rights which belong to the individual. Foremost among these is the right to acquire, enjoy and dispose of private property. It has been justly said that "in a free government, almost all other rights would become worthless if the government possessed an uncontrollable power over the private fortune of every citizen. One of the fundamental objects of every good government must be the due administration of justice ; and how vain it would be to speak of such an administration when all property is subject to the will or caprice of the legislature and the rulers." Yet, whenever the preservation of political society demands, all these rights must yield to the public necessity—for the preservation of the state the individual must suffer.

The arbitrary right of a government to divest an individual of his property is no more recognized in a despotic than in a free country. All governments hold the rights of private property as sacred, and in fact their chief existence is for its preservation. What people pay for this protection is the subjection of their property to such conditions as will enable others to exercise their rights and privileges. The very conception of government presupposes the right of compassing the ends for which it exists. In accomplishing this purpose the private property of every individual is subjected to what may be termed three great attributes of sovereignty in every state ; the right of eminent domain, the right of taxation, and what is known as the police power.

The term eminent domain is applied to that right inherent in every state to appropriate and control individual private property for the public benefit whenever the public safety, necessity, convenience or welfare may demand. This power has been variously defined, but the above seems to be as comprehensive as can be given.

The right of taxation is the right vested in a sovereignty to compel its citizens to contribute toward the maintenance of the government and the accomplishment of the ends for which it is created.

The police power of a state, in its comprehensive sense, embraces the whole system of internal regulations, by which the state seeks not only to preserve the public order and to prevent offences against its sovereignty, but also to establish for the intercourse of citizen with citizen, those rules of good manners and good neighborhood which are calculated to prevent a conflict of rights, and to insure to each the uninterrupted enjoyment of his own so far as it is reasonably consistent with a like enjoyment of rights by others.

These three attributes of sovereignty rest upon substantially the same foundation. The exercise of each affects private property and may encroach upon individual rights. Much confusion has arisen in the jurisprudence of nearly all of the United States through incorrect conceptions as to the precise distinctions of these three separate rights. It is proposed here not to dwell minutely upon these confusions, but to give a few of the leading features pertaining to the right of eminent domain. The other two of the fundamental rights of sovereignty do not bear so directly and harshly upon the accepted inalienable rights of private property as does the latter.

The distinction between the taking of private property by taxation and by the power of eminent domain may be undefinable with precision. In principle the two seem somewhat blended. Both are the exercise of the sovereign power over private property; both are requisitions for the public use and benefit. And in both cases the individual is presumed to receive, or does in fact receive, an equivalent for loss thus occasioned. Untrammelled by the various conflicting decisions of the courts of the several states, a safe rule may be deduced from a few simple and well-settled principles. In American jurisprudence, it may be assumed as fundamental that an individual is protected in the enjoyment of his property, except so far as it may be taken in one of two ways, to wit: as a public tax, upon principles of just equality, for governmental purposes, or taken for a public use with a just compensation. The latter is, in effect, the changing of the class or kind of property for an equivalent of some other class or kind of property—simply depriving the individual of his right to an enjoyment of the original or particular class or kind. Taxation, on the contrary, exacts property from the individual—usually in the form of money—as his share of the public burden, for which the individual receives, or is supposed to receive, a just equivalent in benefits conferred by government and in the proper application of the tax. But when private property is taken under the power of eminent domain, it is taken not as the owner's share of a public burden, but as so much more than his share, for which the rest of the public, represented by the government or state, must render some equivalent. For the public welfare he is deprived of the enjoyment of that particular class or kind of property for which he is compensated in another class or kind.

The distinction between the right to interfere with private property under the police power and the right under the power of eminent domain is not easy to draw. Under the police power there is only an imperfect moral obligation to make compensation, and the taking must be by an overruling necessity. For instance, to prevent the spreading of fire other houses or property may be destroyed; the same may be done to prevent the rages of pestilence or any great public calamity; and all this without subjecting the actors to personal responsibility for the damages which the owners thereof have sustained. The want of compensation to the owner in all cases under the exercise of the police power is generally based upon disaster, fault or inevitable necessity; while the right to compensation under the exercise of the power of eminent domain is founded, not in calamity or fault, but in public utility. These clearly mark the cases distant from the border line between the two powers, but in or near to this border line they begin to shade into each other, and it is difficult to say when compensation becomes a duty and when it does not.

But since the right of eminent domain is the attribute of every sovereignty, where, or in what part of the machinery of that sovereignty does the exercise of this right lie? To this there can be but one answer. Of the three branches of government, the executive, the judiciary and the legislature alone has the right, for the reason that that branch is the creating part of the government, and it belongs there whether a single individual or a body of individuals collectively control that portion of the government. In this country, of course, it is vested in the legislative assemblies. Nor can the right be exercised by any political body subordinate to the legislature, unless the latter has specially conferred its right upon the former. The power consequently lies dormant until the legislature acts, and when it does act, the occasion for and the mode of taking must be preserved as well as the conditions and the agencies under which it may be exercised.

The power thus intrusted to the legislature should never be used except when the public interest and welfare clearly demands it. It is in derogation of the rights of private property, and the legislative enactments authorizing its exercise must necessarily be strictly construed — authority will not be inferred or enlarged by implication. It is a well established principle in American jurisprudence that "the individual shall be secure from the arbitrary exercise of the power of government, unrestrained by established principles of private rights and distributive justice." This means in legal parlance that no power exists in the legislature or elsewhere to take private property, either with or without compensation, without the owner's consent, except by "due process of law." No judicial condemnation is necessary to subject property to this power, and the legislative declaration that the necessity exists must be held for this purpose the "law of the land." It may be received either directly or ni directly by the legislative body and can be restrained by the judiciary only when it has exceeded its limits, or its authority has been perverted or abused.

The impossibilty of the State to act through the individuals composing it compels the employment of agents for the purpose of exercising its power of eminent domain; and even the legislative body, where the exercise of the power primarily rests, through its inability to personally supervise all of the acts necessary to be done by virtue of it, must distribute the power still further. It is within the sole discretion of the legislative body, subject only to constitutional limitations, to determine the agencies for this purpose. The donee of the power may be an individual, association of individuals or corporations; and wherever delegated a personal trust is imposed upon the donee which cannot be re-delegated or transferred without express legislative sanction. Strictly speaking, the legislature does not delegate the power, but employs agents in its exercise. A State cannot divest itself of sovereign power; therefore, the selection of these agents — the donees of the power—is solely within the discretion of the legislature.

The determination of whether the necessity for the taking of private property exists is a question of purely political character. Though the final decision rests with the legislative body, the parties directly interested having no constitutional right to a judicial hearing upon the facts, yet by legislative authority the question may be referred to any tribunal for adjudication.

What constitutes "a taking of property" under the power has been productive of a vast amount of litigation, but in general it may be defined as the effect of any proceeding which vests in the public the right of using property.

There are two ways in which the exercise of this power may affect property. The first is by dispossession; through which any temporary or permanent change of title, or exclusion of the owner from its enjoyment, in whole or in part, is a "taking;" and the second is by an injury to the property or its easements. Among the injuries to the property itself are included all irreparable and permanent injuries or temporary injuries of material detriment to the owner, and any additional burden or servitude imposed on property not amounting to a dispossession of the owner is still a "taking" under the head of injuries. Yet mere preliminary surveys preparatory to a taking are not of themselves an exercise of the power of eminent domain, and, for unnecessary inconvenience or injury to the owner, those entering his premises are liable in trespass. For instance, a surveying party preparatory to condemnation proceedings for the right of way for a railroad entering upon a man's farm may take all the measurements necessary and can do so as long as they do nothing to interfere with the former's rights of possession in his lands; but they cannot cut down a tree, or make a pile of stones in the centre of a cultivated field, or do anything to interfere with that man's enjoyment of his property; if they do, they are personally liable to him in trespass, and he may recover damages therefor.

When property has a public use impressed upon it, it does not constitute a taking to burden it with a new and similar use; but the imposition of an additional burden and a dissimilar public use does constitute a taking. Accordingly, changing the character of a highway from a public highway to a plank road, or the laying out a turnpike over a common highway, or converting a turnpike into a common highway; the erection of a bridge on lands acquired for a ferry landing; the use of a plank road by a railroad; laying a railroad on a canal site, and running a horse-railroad in a street (except in New York, where the fee of the street is vested in the public), thus not taking the property of an abutting owner, are all held not to impose an additional servitude on the property so impressed with public use—the change is from one public use to a similar public use.

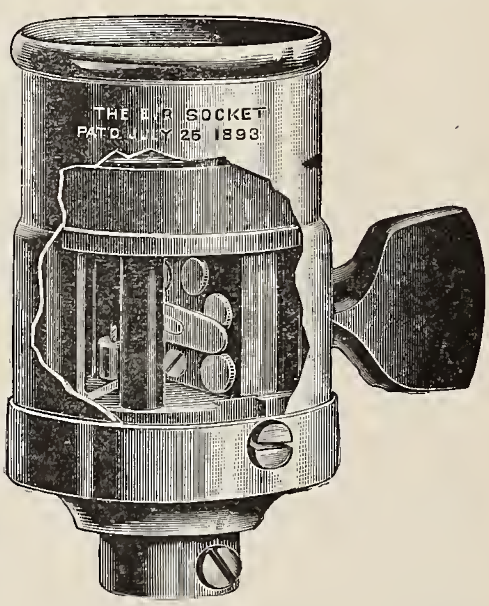
(*To be Continued.*)

THE N. E. L. A. CONVENTION.

Mr. C. O. Baker, Jr , master of transportation of the National Electric Light Association, reports that the New England Passenger Association has granted a rate of a fare and one-third, on the certificate plan, from all points in their territory to New York and return, for all delegates and representatives attending the nineteenth convention of the National Electric Light Association, to be held in this city May 5, 6 and 7.

CANDLE-POWER CONTROLLED.

Some articles create a demand for themselves; for others there has always been a demand. A very elegant piece of mechanism has been placed before the public by the manufacturers of the "E. R." ("Economic Regulating") socket.



It is a regulating device which places the candle power of any lamp completely within the control of the user.

Four carbon pencils can be successively thrown into series by simply turning the key. Ordinarily when the key is turned the current rushes in and greatly assists in the rapid deterioration of the lamp filament. But by this means a gradual light can be thrown on, making it an almost indispensable article for sick rooms, and a constant source of pleasure to the unfortunate possessors of sensitive eyes.

As a night lamp it has found an immediate use, and fills a long felt want.

The company is very busy at present filling the orders that are constantly arriving. The voltage the sockets are adapted for varies from 100 to 110 volts, and a special socket for 50 to 55-volt circuits is ready for the market.

The Electric Co. has its offices at No. 56 Broadway, where it receives all orders.

HONORING FRANKLIN IN PARIS.

Several hundred persons, on March 8, attended the unveiling in Paris of a memorial tablet that has been erected on the site of the villa at Passy occupied by Benjamin Franklin from 1777 to 1785. It was at this villa that Franklin erected his first lightning conductor. J. B. Eustis, the American Ambassador, acknowledged the gift of the tablet.

SPECIAL NOTE.

NOTICE OF REMOVAL.

In order to increase our facilities for manufacturing and shipping our goods, we have moved our office and factory to 433 State street, Rochester, N. Y., where we will be pleased to receive your orders.

Yours truly,

Beers Bros.

Telephone Notes.

Brunswick, Md.—J. J. Murray, of Frederick, Md., contemplates establishing a telephone exchange in Brunswick.

Ft. Worth, Tex.—The Mansfince Telephone Co. has been incoporated with a capital stock of $2,500.

Fort Collins, Colo.—The Northern Colorado Telephone Co. incorporated; to operate a line from Fort Collins to Cheyenne. Incorporators, T. J. Montgomery, A. W. Scott and A. J. and Ed. J. A. Annis.

Lewes, Del.—A movement is under way for the establishment of a telephone line to connect the railroad station at Lewes with points in the town.

Sibley, Ia.—The Sibley Town Council granted the Spirit Lake Telephone Co. a ten year franchise. A movement is on foot to secure electric lights.

Schroon Lake, N. Y.—The Schroon Lake and Crown Point Telephone Co. has been incorporated to connect Schroon Lake, Crown Point and Elizabethtown; capital, $4,000. Directors, E. J. Dunn, C. H. Wilson and others, of Schroon Lake.

Spokane, Wash.—The Spokane and Columbia Telegraph and Telephone Co. incorporated; capital, $75,000; incorporators, N. R. Stone, Jay H. Adams, L. F. Gordon, of Spokane, and Angus Macnish, of Rossland. The object of the corporation is to construct a telephone line during the coming spring to Trail and Rossland, B. C., and eventually to the boundary creek.

TELEPHONE PATENTS ISSUED MARCH 10, 1896.

Selecting and Operating Telephone. Herbert L. Webb, New York, assignor to the Electric Selector and Signal Company, of West Virginia. (No. 555,984.)

Automatic Telephone Exchange System. Moïse Freudenberg, Paris, France, assignor to Roger William Wallace, London, England. (No. 556,007.)

Telephone Speaking-Tube System. John S. Stone, Boston, and George K. Thompson, Malden, assignors to the American Bell Telephone Co., Boston, Mass. (No. 556,034.)

FOR UPTOWN TELEPHONE SUBSCRIBERS.

An uptown branch of the Contract Department of the Metropolitan Telephone and Telegraph Company has been established at 113 West 38th street (one door from Broadway), where all business relating to the supply of telephone service can be transacted as readily as at the main office at 18 Cortlandt street. There are 14,000 telephone stations in New York City. Metallic Circuit Service, Rapid, Efficient, Permanent can be had from $75 a year.

NEW TELEPHONE COMPANIES.

Atlanta, Ga. — The Georgia and Florida Telephone Construction Company has been incorporated by J. M. Blakeley, of Michigan; S. Baer, of Douglasville, Ga.; J. James, of Douglasville and others; capital stock, $1,500,000; to contract for the construction of telephone systems, etc.

Atlanta, Ga.—J. M. Blakeley, of Michigan; S. Baer, of Douglasville, Ga , J. S. James, of Douglasville, Ga., and others, have incorporated the Atlanta Telephone Co. with a capital stock of $250,000, to establish telephone systems and exchanges.

Edgefield, S. C.—L. R. Weeks, L. B. Jones and others, have incorporated the Carolina Telephone Exchange Co.; capital stock, $10,000.

ART FOR THE PUBLIC.

The Phœnix Glass Co. have brought their latest catalogue before the public eye.

The beautiful illustrations within represent in a most striking manner the globes and artistic wares as they really are. Apparently no expense has been spared to make the catalogue a success, and we do not in the least doubt the fulfilment of their expectations.

Nothing so helps to beautify electric lighting and to add elegance and finish to its effects as fine globes. The samples we see represented in the catalogue of the company are evidence that this feeling has been pre-eminent in their minds. Their stalactite, etched and cut glass globes are ornaments in themselves.

Like the immortal bird they typify, they pass through the fire of criticism rejuvenated and unsurpassed.

Possible Contracts.

Elmira, N. Y.—An electric railroad is to be built from Elmira to Watkins, twenty miles, and through cars will be run to connect with Seneca Lake boats. It will be completed about July 1st.

Harrisburg, Pa.—Darby, Lansdowne and Philadelphia Electric Co., to build an electric line six miles long in Delaware County, between Darby and Lansdowne. Capital, $36,000. President, William Simpson, jr., Overbrook.

Pittsburgh, Pa.—Plans are being prepared for a new nine-story fireproof hotel, to be erected on Fifth avenue in the rear of the old Splane property building by D. F. Henry, who owns the property.

New York City.—The old Carleton House, at Frankfort and North William streets, will be torn down and a new fireproof office structure erected in its stead.

Boston, Mass.—A new apartment hotel, to cost $350,000, to be known as Trinity Court, is to be erected on the corner of Dartmouth street and Trinity place, by the executors of the estate of Eben D. Jordan.

Weston, W. Va.—Plans have been adopted by the R. P. Camden Hotel Co. for a large three-story hotel, bank and opera-house; building to have its own electric light plant, etc.

Gloversville, N. Y.—The Mountain Lake Electric Railroad Co. has organized and articles of incorporation will be filed. The capital stock is $60,000. The distance to the lake is five and a half miles. Tne cars will be run only in summer. Directors, Charles King, Richard Ansell, George Hendrie, Johnstown; James G. Haggart, Samuel L. Foster, Bleecker; Alvah J, Zimmer, Robert J. Williams and Dexter R. Bartlett, of Gloversville.

New York Notes.

Warren P. Freeman, of The Warren P. Freeman Co., No 106 Liberty street, is without doubt one of the most practical machinists and expert electricians in the States.

The writer has investigated the latest positions he has held and the various interests he has represented, and finds upon the written statements of officers of various companies that he is by all regarded as an expert.

His attitude towards them, in whatever capacity, has always been one of diligence and honesty.

The present business of Mr. Freeman is in a flourishing condition. They have every facility for developing inventions, making models of an electrical or mechanical nature and special machinery to meet with all classes of work.

Work from drawings is a specialty, and their success in such work is merited by the care and forethought of its promulgator.

J. F. Macartney, New York representative of The Ohio Brass Co., reports good business in railway supplies.

The *Street Railway Review* reports that the General Electric Co. has enjoined the Eiberite Co. from making overhead electric railway switches.

J. H. Hanna, New York representative, reports that The McGuire Mfg. Co., sold 30 trucks to the Holmeburg, Tacony and Frankford Railway Co., Pa. The company is very busy and asks for time orders.

CANADIAN LETTER.

BY OUR MONTREAL CORRESPONDENT.

Electric Railways.

Amherstburg, Ont.—Applications have been made to the government for a charter for the construction of an electric railway from Amherstburg to Harrow.

Stratford, Ont.—A project for the construction of a steam or electric railway from Embro to Stratford, a distance of seventeen miles, is being considered by the Board of Trade.

Hamilton Radial Railway.—It is rumored that the Hamilton Radial Railway Company proposes to buy the old post-office building on James street, north, and convert it into a station.

Chatham, Ont.—The Chatham City and Suburban Railway Company are seeking incorporation, to construct an electric railway through the city to a point near the Raleigh and Harwichtown line at Lake Erie, with a branch through the township of Dover to the town of Petrolea.

Newmarket, Ont.—The installation of an electric light plant has been decided upon by the town council. Estimated cost, $8,000.

Hamilton, Ont.—G. F. Simpson is promoting an enterprise to supply electricity for lighting and power purposes.

Montreal, Que.—The Lachine Rapids Hydraulic and Land Company will receive proposals until the 25th inst for generators, etc., necessary for the transmission of about 16,000 horse-power. W. McLea Walbank, managing director, 214 St. James street.

Hamilton Radial Railway Co.—The Hamilton Radial Railway Co., and Lake Shore Electric Railway Co, have applied to the Nelson Township Council for right of way over a portion of the Beach. The first mentioned company proposes to build from Hamilton to Burlington this year. The Lake Shore Company has a charter to build a line from Hamilton to Oakville.

St. Catharines, Ont.—The Lincoln Radial Electric Railway Co. is applying for a charter to build lines from St. Catharines to the villages of Jordan, Beamsville and Grimsby, with a branch to Smithville and to Port Dalhousie and also to Queenstown, with power to buy the Lincoln Street Railway Traction and Light Co., Ltd.

J. Alcide Chaussé.

ELECTRICAL and STREET RAILWAY PATENTS

Issued March 10, 1896.

555,922. Insulating-Support for Boxes Containing Electrical Apparatus. Thomas H. Brady, New Britain, Conn. Filed Jan. 4, 1896.

555,937. Conduit-Railway System. Oscar A. Enholm, New York, N. Y., assignor to W. Dean Smith, same place. Filed June 15, 1895.

555,938. Individual-Call System for Autographic Telegraphs. Harry Etheridge, Pittsburgh, Pa., assignor, by mesne assignments, to the Gray National Telautograph Company, Richmond, Va. Filed Feb. 1, 1892.

555,958. Travelling-Contact Device. Myron D. Law, Washington, D. C., assignor to Albert G. Wheeler, Chicago, Ill. Filed Sept. 28, 1894.

555,959. Underground Trolley. Myron D. Law, Washington, D. C., assignor to Albert G. Wheeler, Chicago, Ill. Filed May 9, 1895.

555,963. Dynamo-Electric Machine. William M. Mordey, London, England. Filed Apr. 21, 1891. Patented in England June 8, 1887, No, 8,262; in France Jan. 7, 1888, No. 188,024; in Belgium Mar. 15, 1888, No. 81,-044, and in Italy June 30, 1888, XLVI, 103.

555 968. Electric Gas-Lighting Burner. James A. O'Neill and George A. O'Neill, Boston, Mass, assignors to the Electric Gas-Lighting Company of Maine, same place. Filed Nov. 16, 1895.

555 979 Electric Elevator. Humphrey R. Smith, Chicago, Ill., assignor to the Winslow Brothers Elevator Company, same place. Filed Mar. 23, 1895.

555,984. Selecting and Operating Telephone. Herbert L. Webb, New York, N. Y., assignor to the Electric Selector and Signal Company, of West Virginia. Filed Mar. 18, 1893.

555,992. Electric Meter. Charles Wirt, Philadelphia, Pa., assignor to the American Electric Meter Company, same place. Filed Nov. 30, 1894.

556,007. Automatic Telephone-Exchange System. Moïse Freudenberg, Paris, France, assignor to Roger William Wallace, London, England. Filed Jan. 10, 1896.

556,027. Secondary-Battery Plate. Izak Samuels, New York, N. Y. Filed Sept. 10, 1894.

556,028. Circuit-Block. Duny A. Schutt, Peru, Ind., assignor to the Peru Electric Manufacturing Company, same place. Filed Nov. 16, 1895.

556,034. Telephone Speaking-Tube System. John S. Stone, Boston, and George K. Thompson, Malden, assignors to the American Bell Telephone Company, Boston, Mass. Filed Sept. 28, 1895.

556,038. Electrolytic Apparatus. Michael H. Wilson, Brooklyn, N. Y. Filed May 8, 1895.

556,046. Rail-Bond for Electric Railways. Fred H. Daniels, Worcester, Mass. Filed June 26, 1895.

556,061. Street-Car Fender. David Leib, Columbus, Ohio. Filed July 19, 1895.

556,072. Electric Signalling System for Railways. George L. Thomas, Brooklyn, assignor to the Hasell Perfected Railway Signal Company, New York, N. Y. Filed Jnne 11, 1895.

556,079. Electric Car-Lighting System. Albert H. Armstrong, Schenectady, N. Y., assignor to the General Electric Company, of New York. Filed May 31, 1895.

556,138. Electric Gas-Igniter. James P. Doyle, Buffalo, N. Y., assignor of one-fourth to Edward W. Wunch, same place. Filed Oct. 29, 1895.

556,139. Electric Block System for Railway-Crossings. Axel E. Ellis, Boston, Mass. Filed Nov. 8, 1895.

556,161. Electro-Therapeutic Body-Wear. George Quarrie, Brooklyn, assignor of one-half to Charles J. Kintner, New York, N. Y. Filed May 3, 1894.

556,176. Brush for Dynamo-Electric Machines. Frederick J. Chaplin and Robert Chaplin, Birmingham, England. Filed Dec. 10, 1895. Patented in England Oct. 24, 1895, No. 20,028.

556,183. Electrically-Operated Railway-Gate. Benedikt Haberthur, Logansport, Ind., assignor of one-half to Joseph Mandel, same place. Filed Oct. 15, 1894.

556,185. Snap-Switch. Albert B. Herrick, Bayonne, N. J., assignor to the General Incandescent Arc Light Company, New York, N. Y. Filed Nov. 23, 1895.

556,189. Electric Gas-Lighting Device. John B. Jackson, Philadelphia, Pa., assignor to Ellis Stokes, Jr., trustee, same place. Filed Aug. 15, 1895.

556,210. Electric Railway. Harry C. Reagan, Jr., Philadelphia, Pa. Filed Sept. 6, 1895.

556,224. Electric Cloth-Cutting Machine. Arthur K. Thyll, New York, N. Y., assignor to the Electric Cutter Company, same place. Filed May 31, 1893. Patented in England Dec. 7, 1893, No. 23,581; in France Dec. 7, 1893, No. 224,621; in Belgium Dec. 7, 1893, No. 107,-524, and in Germany Dec. 8, 1893, No. 78,763.

556,264. Electric Switch. Theodore W. Gabel, Lancaster, Pa. Filed May 13, 1895.

556,267. Car-Fender. William Hemstreet, Brooklyn, N. Y. Filed Aug. 1, 1895.

556,311. Closed-Conduit Electric Railway. Ernest R. Esmond, New York, N. Y., assignor of one-half to William C. Clarke, Wakefield, R. I. Filed Oct. 18, 1893. Renewed Jan. 8, 1896.

556,315. Electric Snow-Plow. Henry H. Kryger, Minneapolis, Minn. Filed Sept. 10, 1891.

556,320. Electric Railway. Eben M. Boynton, West Newbury, Mass. Filed Mar. 6, 1895.

556,321. Electric Underground-Trolley Railroad. George D. Burton, Boston, Mass., assignor of one-half to William S. Silver, Orange, N. J. Filed Dec. 21, 1895.

556,322. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa., assignor to the Electric Car Company of America, same place. Filed July 19, 1886.

ELECTRICAL AGE

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NEW YORK, MARCH 28, 1896.

CONTENTS.

THE SIX O'CLOCK RUSH on the Brooklyn Bridge will now be considerably modified and the unoffending ribs of bread-winners better protected than ever. The General Electric Company have been awarded the contract for the equipment of sixteen new electric cars for bridge service. The delay occasioned by the coupling and uncoupling of engines will be dispensed with and an effective saving of time made by the use of these new motor cars. The cost of each car will be $3,645, and the total cost of the plant estimated at $300,000 The new cars will have 25 per cent. more power and will switch the car from track to track at 45 seconds headway. According to report, the Westinghouse Company refused to give a test at their own expense and thus left the field solely to the General Electric Company.

ELECTRICITY IN THE MUSCLES.—The existence of a current of electricity in the living tissues of the body was first noticed by Galvani. Not only do these currents flow in both muscles and nerves, but they are capable of investigation in a scientific manner, as they seem to be governed by definite laws. Du Bois Raymond has shown the presence of these currents and produced a series of results of an interesting nature. When a muscle is suddenly contracted, there is an instantaneous reduction of strength in the normal flow of electricity. If the contractions be very rapid the current ceases, to flow once more, however, when the muscle is at rest. The electric torpedo controls its discharge by a lobe of the brain. Mattenci having shown in the case of a living fish that the removal of this special centre rendered it powerless to inflict a shock. A very complex relationship seems to exist between the flow of a nerve current and an electrical discharge.

ANODE RAY.—The doubt that has been expressed so frequently as to the true source and nature of the X-ray has again been given voice to in the columns of our paper by so eminent an authority as Elihu Thomson. The penetrative power of these waves and the immediate distinction they make between metals or conductors and so-called insulators is a matter of the greatest wonder to the public mind. The species of wave movements commonly called light have lost their footing, and light is now known by other names; for there is light to which the eye is blind and the optical sense completely unconscious of. "The summary of effects," as Thomson calls them, are the results of his own experience and observation. Their bearing upon the future explanation of the Roentgen ray, and use as a means of distinguishing between the anodic and cathodic effects, every scientific man will at once recognize. Yet the tendency of modern research—the strangely varied opinions of leading men—are slowly approaching a focus. The ray may be an emanation from the anode pole—the noticeable differences may be simply due to the existence of two antithetical conditions—a state of positive and negative electrification, and it may be that the ordinary and expected radiation is at once affected by this circumstance, that the influence of so great a strain creates a wave, at present the subject of so much earnest inquiry.

POST-OFFICE APPROPRIATION BILL.

A system was once evolved by an ambitious inventor which was to have whirled mail across the country at the rate of six hundred miles an hour.

Its use, as a means of rapid transit was also advocated.

The public did not seem to imbibe the spirit of its ardent inventor, and the postal service throughout preserved a sphinx-like silence.

It did not forget, however, the value of the arguments presented, and by its latest move has shown its full appreciation of the necessity for a convenient and rapid means of mail transportation. It has impressed the government so favorably in this respect that an appropriation of one hundred and fifty thousand dollars has been allowed. Compartment cars to an extent compatible with the above amount will be built to run on the cable and trolley roads, covering such routes as are authorized by the Postmaster-General. Furthermore, a definite rate of compensation per mile has been decided upon for roads carrying the mail in pouches, based upon the distance and weight. This will mean a nice plum to some traction companies and a decided improvement upon the present postal service.

Is the Corona of the Sun an Electrical Phenomenon ?

Introduction.

THE mysterious halo of light seen around the sun during a total eclipse was first described in 1706. Vast streams of light were noted and examined by Lonville and Halley in 1715. The peculiar character of these discharges, their fluctuating brilliancy and changeable nature, gave rise to many widely different opinions. Maraldi in 1724, Antonio de Ulloa in 1778 and Bonditch and Ferrer in 1806 made mention of their opinions and observations regarding this solar crown. An attempt was made by several astronomers to arrive at some general conclusion which would assist in explaining the meaning of these streamers, and during the total eclipse of 1842 Airy and Arago turned their attention particularly towards it for this purpose. Even with the closely scrutinizing gaze of such eminent scientists the decision of the question lay in complete abeyance. Arago specially refers to this state of affairs in the following words : "The disagreement of the observations taken in different places by skilful astronomers of one and the same eclipse have involved the question in fresh obscurity, so that it is impossible to come to any conclusion as to the cause of the phenomenon."

The question naturally resolves itself into the following : Is the corona a real substance or is it merely due to a diffraction of the sun's rays near the lunar periphery ?

The radiating streaks often occupy a curious position and the length of them at times exceeds 9,000,000 miles. Profs. Young, Langley, Abbe and Newcomb have observed the enormous scope of the solar nimbus. In 1868, 1871 and 1878 sketches were made of this remarkable phenomenon.

The possibility of its being merely an optical delusion has been swept aside. Of whatever nature it may be, it has thus far evaded the attempts of able men to decipher it.

A writer has said that it consists, in part at least, of gases *far more tenuous* than any with which we are acquainted on our earth.

The corona has been reproduced by Prof. Michael Pupin of Columbia College. The very photographs obtained show a strong resemblance to those taken direct from an eclipse by dryplate and telescope.

Possibly the corona does consist of a tenuous gas. The least to be done is to republish the best known evidence tending to throw light on this much argued question.

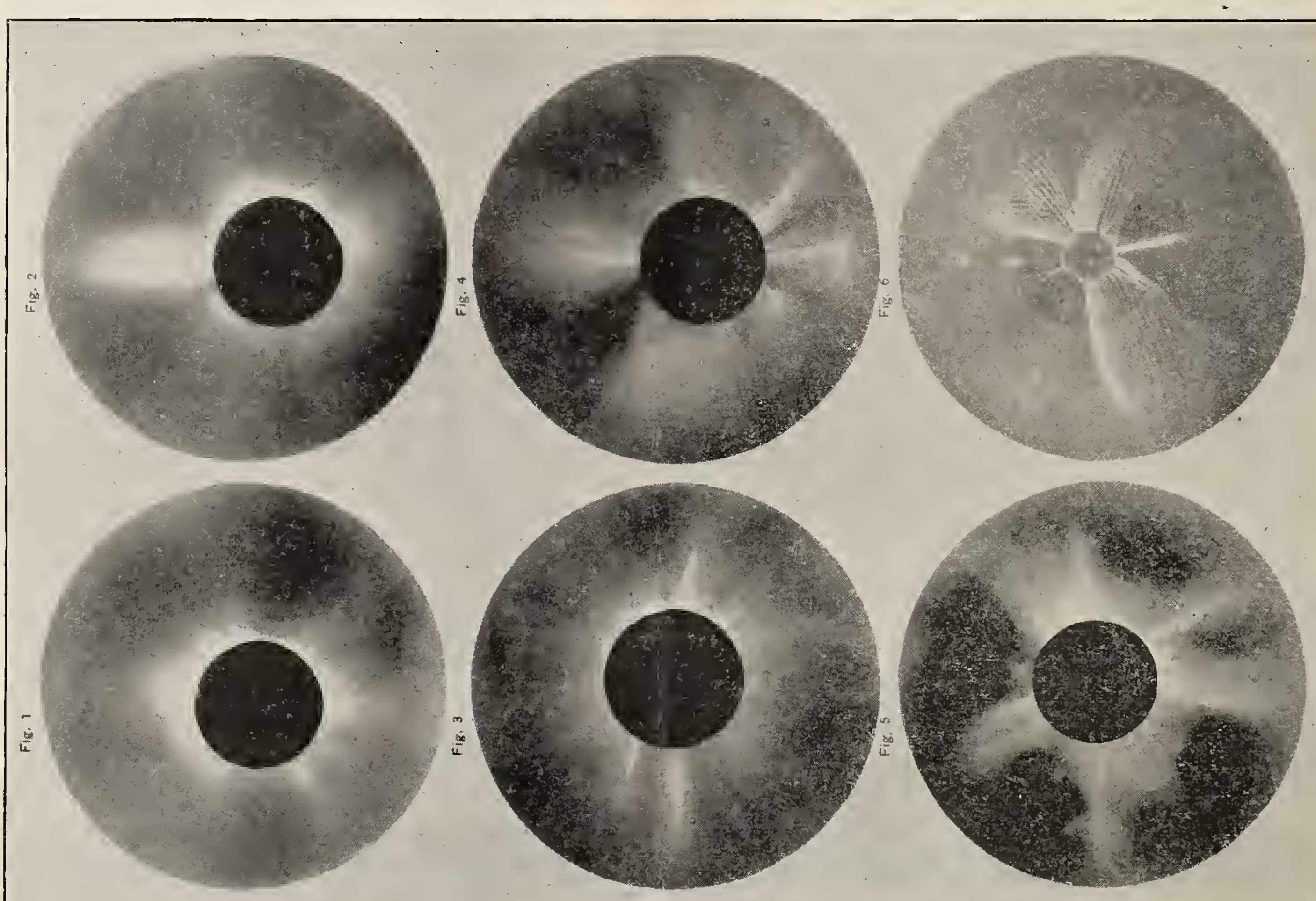
Let us, then, regard it from a new standpoint, in fact, let the question, better answered than ever by the following article, be again presented—and the surprising results —the comprehensive survey make way anew for conscientious investigators.

On Electrical Discharges Through Poor Vacua, and on Coronoidal Discharges.*

M. I. PUPIN.

The behavior of electrical discharges through poor vacua does not seem to have received the attention of experimental investigators which it deserves. This may seem strange in view of the uncertainty of our knowledge of the process by which the transfer of electricity through gases takes place. Considering, however, that it was generally customary to employ in experimental investigations of this kind a vacuum jar with metal electrodes in connection with an electric generator of small capacity, it is easily explained why the discharges through poor vacua should have received so much less attention than the discharges through high vacua and the spark discharges through gases at ordinary pressures. Neither the vacuum jar nor the working of the electric generators ordinarily employed admitted of rapid, easily adjustable, but essential variations in the conditions of the experiment; as, for instance, variations of the size and shape of the electrode, of the frequency of the discharges, of the strength of the electromotive force, etc. But as I shall point out in the course of this paper, it is through these very variations that certain fundamental features in the character of an electrical discharge through poor vacua are brought out prominently.

The fact that electrical discharges in poor vacua re-



PHOTOGRAPHS OF ARTIFICIAL CORONA. (PUPIN.)

semble in many characteristic details the appearance and behavior of the solar corona, attaches additional interest and importance to that class of experimental investigations which are pointed out, only, in this paper. Neither time nor facilities permitted me to aim at anything approaching completeness. The principal aim in my presenting this paper was to recommend my subject and my method of investigating it to those who have command over a larger experience and skill in experimental investigations, and who also have more leisure and greater experimental facilities than I could even pretend to possess.

DESCRIPTION OF THE EXPERIMENTAL METHOD.

A brief description of the method by which I obtained my vacuum discharges seems in place now. It consists in producing an electrical current in a vacuum by means of the condenser effect of tinfoil coatings or other conductors placed on the outside of a vacuum jar.

The following experiment, which I performed over a year ago, will explain my meaning more fully. The poles of a small Ritchie induction coil are connected to two glass beakers containing water. The primary is fed by ¼ HP alternator, giving an alternating current of about 80 periods. A resistance box regulates the strength of the primary current. The speed of the motor which drives the alternator regulates the periodicity of the current.

A vacuum jar consisting of two glass bulbs (each about 8 c. m. in diameter) connected by a tube of narrow bore, was immersed into the beakers, one bulb in one beaker, the other into the other. The jar contained rarefied air at about 5 mm. pressure.

As soon as the bulb reached a certain depth a discharge took place, producing a perfectly steady and continuously diffused crimson luminosity. The intensity of the luminosity increased with the increase of the surface of contact between the water and the bulbs. The same effect was produced by substituting a Holtz machine for the induction coil and the alternator. In this case the effect was due, of course, to the oscillations produced by the spark discharge between the poles of the machine. The two vacuum bulbs with the water surrounding them act like two condensers connected in series by the narrow tube. It seems superfluous to describe the obvious experiments which I had to perform to prove the following relation :

The intensity of the luminosity increases with the condenser surface of the bulbs, with the frequency of alternations, and with the effective electromotive force of the charging apparatus. Other things being equal, the total amount of light produced will increase with the increase of the conductivity of the vacuum. This relation may have been understood before, but to my knowledge it was never clearly stated.

(*To be Continued*).

DANGEROUS QUALITIES OF ACETYLENE

Photometrical tests have shown, a German writer remarks, that for the production of a light of one normal candle-power 0,6 liter of acetylene is required per hour if proper burners are used, while for the same lighting power ten or twelve liters of coal gas used in ordinary burners are consumed. Acetylene, however, possesses different qualities, which are of a somewhat dangerous nature, and have to be considered with caution—its action upon copper or copper alloys, for example, forming a brownish substance which is highly explosive, such metals, therefore, being unsuitable for use either inside the conduits or for glow bodies, if acetylene is employed as a lighting material, while iron is of neutral conduct toward acetylene ; in the next place, a mixture of acetylene and air is explosive, the highest exploding power being reached in a mixture of one part of the former and twelve of air ; finally, like all carburetted hydrogen gases, acetylene is very poisonous also.—*The Industrial World.*

* Read before the National Academy of Sciences, Washington, April 22, 1892.

CABLE versus UNDERGROUND TROLLEY.

The *Morning Advertiser* reports a meeting of the State Railway Commission in which President Vreeland advanced his views on the street railway question as follows :

At a meeting of the State Railway Commission, held today in the Chamber of Commerce, the investigation of the serious accident last Monday on the Lexington avenue cable road on One Hundred and Second street was taken up.

President of the Metropolitan Traction Company, H. H. Vreeland, was present in response to a subpœna, and gave an account of the accident from the standpoint of the railway company.

Mary Mulvihill was struck by a cable car at the foot of the hill at the point named and severely injured. Two cars were telescoped by being struck by this same runaway car. The accident was due to the inability to stop the cars by means of the brakes because of the steepness of the hill, which has an inclination of thirty feet to the block.

President Vreeland said that if it had not been for the snow storm the accident would not have happened. He testified that the Lexington avenue line had adopted a system of double sprockets and chains and that every known precaution had been taken against such accidents, and under ordinary circumstances accidents were almost impossible, but that such weather as last Monday was an extraordinary circumstance. Mr. Vreeland said :

"The fact is that an underground electric system is the only true solution of the street railway problem, and we mean to introduce it shortly. If we are permitted we also intend to reduce the grade at One Hundred and Second street fifty per cent. Meanwhile we wish to assure the Commissioners that we will use every precaution to prevent accident."

A number of witnesses were expected who did not appear. Mr. Vreeland's was the only testimony given.

A GREAT ENGLISH INTERNATIONAL EXHIBITION.

A great international exhibition of horseless carriages and cars, self-propelled and other vehicles and cycles—stationary motors—appliances and inventions, organized by the Motor Car Syndicate, Ltd., under the direction of the Motor Car Clnb, will take place at the Imperial Institute. The patron will be Queen Victoria. H. R. H. the Prince of Wales will preside.

MAX OSTERBERG ON "THE ROENTGEN RAY."

The New York Electrical Society held their 173d meeting at the School of Mines, Columbia College, Thursday night, March 19, 1896. The lecturer very ably reviewed the work of Faraday and Maxwell; and finally Lenard and Roentgen's contribution to science. The vacuum was discussed and Roentgen's discovery explained in detail. Various devices to produce the Roentgen effects were clearly elucidated. A longitudinal wave and a transverse wave were practically demonstrated by means of a spiral spring. Lantern slides of work done by various men were shown and the portrait of the great discoverer "Roentgen."

Jersey City, N. J.—The erection of a Masonic temple is contemplated in this city. Right Worshipful Robert Simpson is chairman of the committee appointed.

New York City.—The Metropolitan Railway Co. has been granted permission to extend its lines from Broadway through Broome street to Greene street, from Broadway to Third and Fourth streets, to Wooster street, and through Cortlandt from Broadway to West street.

PRINCIPLES OF DYNAMO DESIGN.

BY

Newton Harrison E.E.

(*Continued from page* 138.)

The value of current that can be allowed to pass from segment to segment is of greater consequence in fact than the pressure.

Arcing can not occur unless the pressure is backed up, so to say, by a current of sufficient strength to cause a dangerous arc. The difference between sparking and arcing seems to be mainly one of degree. The pressure required to cause an arc to start would simply induce a spark were the current limited. The table below will show the number of volts required to create an arc of a dangerous nature.

The general supposition that 20 volts at least is required

DIVISIONS OF COMMUTATORS.

Div.	Angle	Chord	Div.	Angle	Chord	Div.	Angle	Chord
			26	13 51	.2411	51	7 03	.1231
			27	13 20	.2322	52	6 55	.1208
			28	12 51	.2236	53	6 47	.1185
4	90	1.4142	29	12 25	.2162	54	6 40	.1163
5	72	1.1756	30	12	.2091	55	6 33	.1142
6	60	1.0000	31	11 34	.2022	56	6 26	.1122
7	51 26	.8678	32	11 15	.1960	57	6 19	.1102
8	45	.7654	33	10 55	.1902	58	6 12	.1083
9	40	.6840	34	10 35	.1844	59	6 06	.1064
10	36	.6180	35	10 17	.1792	60	6	.1047
11	32 44	.5636	36	10	.1743	61	5 54	.1029
12	30	.5176	37	9 44	.1694	62	5 48	.1012
13	27 42	.4788	38	9 28	.1653	63	5 43	0997
14	25 43	.4451	39	9 14	.1611	64	5 37	.0980
15	24	.4158	40	9	.1569	65	5 32	.0966
16	22 30	.3902	41	8 47	.1532	66	5 27	.0952
17	21 11	.3674	42	8 34	.1495	67	5 22	.0937
18	20	.3473	43	8 22	.1461	68	5 18	.0923
19	18 57	.3291	44	8 11	.1427	69	5 13	.0910
20	18	.3129	45	8	.1395	70	5 08	.0897
21	17 09	.2980	46	7 49	.1364	71	5 04	.0884
22	16 23	.2850	47	7 40	.1335	72	5	.0872
23	15 39	.2723	48	7 30	.1308	73	4 56	.0861
24	15	.2611	49	7 21	.1282	74	4 52	.0849
25	14 24	.2507	50	7 12	.1256	75	4 48	.0838

Div.	Angle	Chord	Div.	Angle	Chord	Div.	Angle	Chord
76	4 44	.0826	101	3 34	.0622	126	2 51	.0497
77	4 41	.0815	102	3 32	.0615	127	2 50	.0494
78	4 37	.0805	103	3 30	.0610	128	2 49	.0490
79	4 33	.0795	104	3 28	.0604	129	2 47	.0486
80	4 30	.0785	105	3 26	.0598	130	2 46	.0483
81	4 27	.0775	106	3 24	.0592	131	2 45	.0480
82	4 23	.0766	107	3 22	.0587	132	2 44	.0476
83	4 20	.0756	108	3 20	.0582	133	2 42	.0471
84	4 17	.0748	109	3 18	.0577	134	2 41	.0468
85	4 14	.0739	110	3 16	.0572	135	2 40	.0465
86	4 11	.0730	111	3 15	.0567	136	2 39	.0462
87	4 08	.0722	112	3 13	.0561	137	2 38	.0459
88	4 05	.0715	113	3 12	.0556	138	2 36	.0455
89	4 02	.0706	114	3 10	.9551	139	2 35	.0451
90	4	.0699	115	3 08	.0546	140	2 34	.0448
91	3 57	.0690	116	3 06	.0542	141	2 33	.0445
92	3 55	.0683	117	3 05	.0538	142	2 32	.0442
93	3 52	.0675	118	3 03	.0534	143	2 31	.0439
94	3 50	.0663	119	3 02	.0529	144	2 30	.0436
95	3 47	.0661	120	3	.0524	145	2 29	.0433
96	3 45	.0654	121	2 58	.0520	146	2 28	.0430
97	3 43	.0647	122	2 57	.0515	147	2 27	.0427
98	3 40	.0640	123	2 56	.0510	148	2 26	.0425
99	3 38	.0634	124	2 54	.0505	149	2 25	.0422
100	3 36	.0628	125	2 53	.0501	150	2 24	.0419

Div.	Angle	Chord	Div.	Angle	Chord	Div.	Angle	Chord
151	2 23	.0416	176		.0356	201	1 47	.0311
152	2 22	.0413	177	2 02	.0355	202		.0309
153	2 21	.0410	178		.0353	203	1 46	.0308
154	2 20	.0407	179	2 01	.0352	204		.0306
155	2 19	.0404	180	2	.0349	205	1 45	.0305
156	2 18	.0401	181	1 59	.0346	206		.0303
157	2 17	.0398	182	1 58	.0343	207	1 44	.0302
158	2 16	.0395	183		.0341	208		.0301
159	2 15	.0393	184	1 57	.0340	209	1 43	.0299
160	2 15	.0392	185		.0338	210		.0297
161	2 14	.0389	186	1 56	.0337	211	1 42	.0296
162	2 13	.0387	187	1 55	.0334	212		.0295
163	2 12	.0384	188		.0333	213	1 41	.0294
164	2 11	.0382	189	1 54	.0332	214		.0293
165	2 11	.0381	190		.0330	215		.0292
166	2 10	.0378	191	1 53	.0328	216	1 40	.0291
167	2 09	.0376	192		.0326	217		.0289
168	2 09	.0375	193	1 52	.0325	218	1 39	.0288
169	2 08	.0372	194	1 51	.0323	219		.0286
170	2 07	.0369	195		.0321	220	1 38	.0285
171	2 06	.0367	196	1 50	.0320	221		.0283
172	2 06	.0365	197		.0318	222	1 37	.0282
173	2 05	.0363	198	1 49	.0317	223		.0281
174	2 04	.0361	199		.0315	224		.0280
175	2 03	.0358	200	1 48	.0314	225	1 36	.0279

Div.	Angle	Chord	Div.	Angle	Chord	Div.	Angle	Chord
226		.0277	251	1 26	.0250	276		.0228
227	1 35	.0276	252		.0249	277	1 18	.0227
228		.0275	253		.0248	278		.0226
229		.0274	254	1 25	.0247	279		.0225
230	1 34	.0273	255		.0246	280	1 17	.0224
231		.0272	256		.0245	281		.0223
232	1 33	.0271	257	1 24	.0244	282		.0222
233		.0270	258		.0243	283		.0221
234	1 32	.0268	259		.0242	284	1 16	.0221
235		.0267	260	1 23	.0241	285		.0220
236		.0266	261		.0240	286		.0219
237	1 31	.0265	262		.0239	287		.0218
238		.0264	263	1 22	.0238	288	1 15	.0218
239		.0263	264		.0237	289		.0217
240	1 30	.0262	265		.0236	290		.0216
241		.0261	266	1 21	.0235	291		.0216
242	1 29	.0259	267		.0234	292	1 14	.0215
243		.0258	268		.0234	293		.0214
244		.0257	269		.0233	294		.0213
245	1 28	.0256	270	1 20	.0233	295		.0213
246		.0255	271		.0232	296	1 13	.0212
247		.0254	272		.0231	297		.0211
248	1 27	.0253	273	1 19	.0230	298		.0210
249		.0252	274		.0229	299		0210
250		.0251	275		.0228	300	1 12	.0209

Div.	Angle	Chord	Div.	Angle	Chord	Div.	Angle	Chord
301		.0208	326		.0193	351		
302		.0207	327	1 06	.0192	352		.0178
303			328			353		
304	1 11	.0206	329		.0191	354	1 01	.0177
305		.0205	330		.0190	355		
306			331			356		
307		.0204	332	1 05	.0189	357		.0176
308	1 10	.0203	333			358		
309			334		.0188	359		
310		.0202	335			360	1	.0175
311		.0201	336		.0187	361		
312			337	1 04	.0186	362		.0173
313	1 09	.0200	338			363		
314			339		.0185	364		.0172
315		.0199	340			365		
316			341		.0184	366	0 59	.0171
317	1 08	.0198	342			367		
318			343	1 03	.0183	368		.0170
319		.0197	344			369		
320			345		.0182	370		.0169
321		.0196	346		.0181	371		
322	1 07	.0195	347			372	0 58	.0168
323			348	1 02	.0180	373		
324		.0194	349			374		
325			350		.0179	375		.0167

By W. B. Cleveland, Forest City Electrical Works.

is necessarily exact, but the fact that the arc will depend upon the number of amperes is very definite. Alfred E. Wiener has experimented with two copper conductors separated from one another by a distance of .04 inch, the thickness of mica insulation in commutators, and has arrived at the following figures for conditions causing an arc :

100 amperes	takes	20 volts.		
50	"	"	21	"
20	"	"	23	"
10	"	"	25	"
5	"	"	30	"
2	"	"	40	"
1	"	"	50	"

These facts are all important in the consideration of limiting pressures and currents for commutator segments.

The number of commutator bars per pole has also received attention from several writers on the subject. The amount of fluctuation in the pressure delivered by a dynamo depends entirely upon the number of these sections in the armature. The greater the number of them the better within certain limits it is for the machine. The number of divisions per pole varies from 20 to 40, depending, as we have already understood, upon the pressure.

Bipolar machines using drum and gramme armatures naturally vary somewhat from each other in this respect.

From cases that have been examined it seems likely that the general conditions are as follows :

Platers.

Current.	Segments.	Volts.
50 amperes	12	4 to 8
100 "	12	6 to 10
200 "	18	6 to 12
400 "	24	8 to 12

Bipolar Dynamos.

Current.	Volts.	Segments.
25	50	36
50	100	36
100	110	42
150	110	48
200	120	60
200	200	72
250	200	84

Should the voltage rise to 300 in any particular case the segments increase in number, although not very quickly. The limit of pressure per segment is greatly determined by the table given and the experience of the designer, or, more properly speaking, his common sense.

The nature of the brush used is a great factor in determining the length of time the commutator will wear. The greatest fault in a dynamo, which is the source of future difficulty, is a temporary arcing at the brushes. An overload will sometimes scar the surface and otherwise unfit it for immediate work. If carefully turned down after the development of such an injury the commutator will be in fair condition again ; negligence of this remedy will only waste the copper and destroy the symmetry of that part.

(*To be Continued.*)

SCIENTIFIC MEETINGS.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The 104th meeting of the Institute will be held at 12 West 31st street, New York City, on Wednesday, March 25, 1896, at 8 o'clock P. M. Prof. Wm. L. Puffer, of Boston, will present a paper entitled "A New Method of Studying the Light of Alternating Arc Lamps." It will be accompanied by experiments.

A meeting of Western members will be held the same evening, Wednesday, March 25, at 8 P. M., at the Armour Institute, 33d street and Armour avenue, Chicago. At the latter meeting the subject will be "The Roentgen Phenomena, Theory and Experiments." It will be presented by Mr. Charles E. Scribner and Dr. James D. Burry, assisted by Prof. W. M. Stine.

Gentlemen receiving this card, who are not members of the Institute, are cordially invited to attend either of the above meetings.

SYNOPSIS OF BUSINESS RECEIVED BY ADVERTISERS IN THE ELECTRICAL AGE.

March 5, 1896.

ELECTRICAL AGE.—Do you know of a really first-class telephone to take the place of the Bell for 125 miles of line with 13 instruments. We are using American Bell, who burn us up with rentals and commissions?

A. W. H., Montana.

March 21, 1896.

ELECTRICAL AGE.—I am in the market for an electrical hoist of some description. The machine must be a combination hoist and electric motor and have a maximum requirement of three tons. Kindly give me the name of some manufacturer as we would like to buy one as soon as possible.

Yours truly,

EDISON ILL. CO., St. Louis, Mo.

March 1, 1896.

ELECTRICAL AGE.—Will you kindly put us in correspondence with some good, reliable manufacturer of composition receiver shells for telephones. We have a large demand for telephone of composition shells.

Yours truly,

AMERICAN SIGNAL CO.

February 28, 1896.

ELECTRICAL AGE.—We desire lowest net prices on electric alarm outfits by the dozen; also prices on bells, clocks, pushes, etc., separate.

Will you kindly place our wants before the manufacturers of these goods, and oblige,

Yours truly,

H. P. J. MFG. CO.

Later orders were received and placed with the manufacturers.

CHICAGO, January 4, 1895.

ELECTRICAL AGE.—Yours of the 2d received. I do not want any boxes with the 2½ inch iron box bells; only want the magnets and hammer fixed together. Sketch enclosed of parts wanted. I do not know the manufacturer. I got my sample from the Ansonia Co.; I do not know where they got it. The magnets fit in an iron frame as shown, with armature and hammer attached. Please get me net prices for 1,000, as they are to be used in a new signal system here.

I am yours truly, A. L. C.

CLEVELAND, OHIO, Feb., 1896.

ELECTRICAL AGE :—Please give my address to the manufacturers of wake-up electric alarm outfits and other novelties and specialties.

I am, yours truly,

J. W. VALENTINE.

CHICAGO, 1896.

ELECTRICAL AGE :—Kindly place our name and address with the manufacturers of bells, batteries and wake-up electric alarm clocks, etc.

UNITED ELECTRIC TELEPHONE CO.

LEXINGTON, GA., March, 1896.

ELECTRICAL AGE :—I am in the market for dynamos, etc., for a lighting plant I will install this spring; please get me quotations from manufacturers.

Yours truly,

E. T. ROANE, Lexington, Ga.

BROOKLYN, N. Y., March 14, 1896.

ELECTRICAL AGE:—We will need a complete outfit in our new factory for power and light, in engines, boilers, etc., this spring.

Yours truly,

A. B. SEE.

ELECTRO PLATING.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

The essential requirements for electro-plating are cleanliness and a slight knowledge of chemical reactions. There is much that may appear to be beyond the scope of the home experimenter in this work, but such is not the case, as the apparatus used is within the means of every careful worker.

The study of electrolysis is based upon the curious though familiar fact that the passage of a current through a solution made of the salts of any metal will cause a deposit to occur.

This deposit may be brought about by the current from a few small primary batteries of closed circuit type or the heavy current of a plating dynamo built and used especially for this purpose. The growing industry of electroplating has made this quite an important branch of the commercial arts. The most common department of plating is comprised under the heads of copper, nickel and silver plating.

The more expanded use of these processes leads to the purification of ores by electrolysis, the extirpation of microbes and microscopic organisms from drinking water, and the treatment of sewage for the purpose of rendering it harmless from a hygienic standpoint and useful as a renovator of the soil.

The smelting of ores and the treatment of aluminum can almost be classed under the same head. The production of fine gold and silver ware, executed by the process of plating on glass, has created a new field in the application of electro-plating to the higher arts.

And the sub-department of electrotyping in all its phases has established a firm footing in publishing and engraving firms.

Almost 100 years ago the first experiments in the depositing of metals was performed in a small way, and from then on until a period of forty years had passed the germ of growth was stayed.

The gradual evolution of the different methods now prevailing grew from that time on.

Electro-plating is the process of depositing a layer of metal on another body by an electric current.

One of the simplest forms of plating coming into notice, and one within the scope of the reader, is the process of copper-plating.

Copper-plating.—A solution is made of pure water and crystals of sulphate of copper.

The copper crystals or bluestone, as it is commonly called, is dissolved in sufficient water to make a semi-saturated solution. The addition of a few drops of sulphuric acid greatly improves the conductivity of the bath. About four tumblerfuls of water to one-half a pound of crystals will suffice.

A plate of pure copper is secured to the positive pole of the battery or dynamo, and the object to be plated to the negative pole. The passage of the current will cover the object with a copper film of gradually increasing thickness.

The purity and excellence of the deposit is subject to the following conditions :

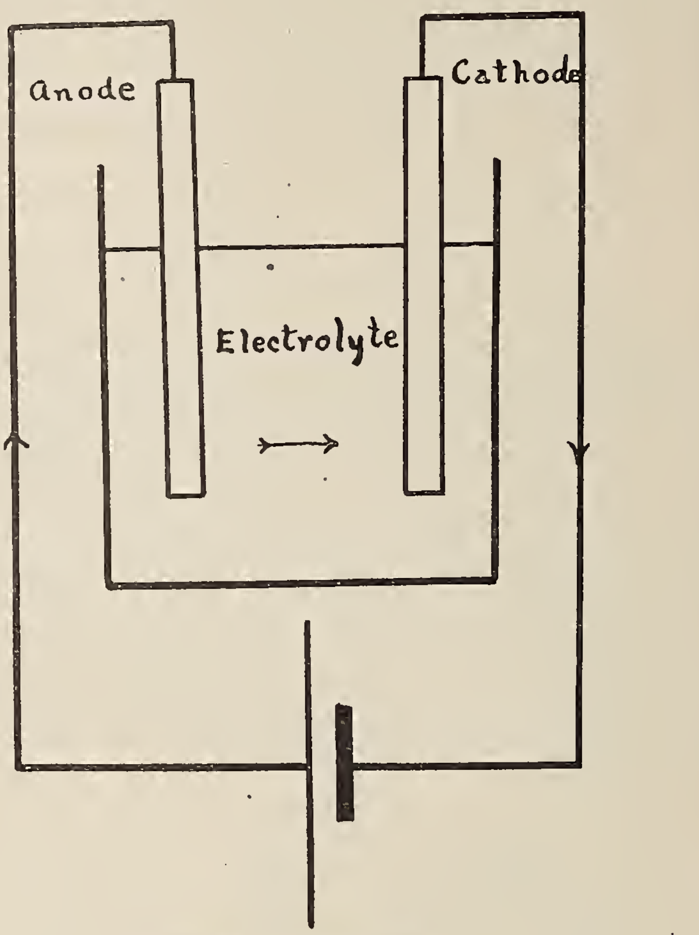
Pressure in volts.
Current in amperes,
Condition of solution.

Pressure in volts in copper-plating is determined by the condition and nature of the bath.

A copper solution acidulated and a copper cyanide require the following :

	Volts.
Copper acid bath,	.5 to 1.5
Copper cyanide bath,	3 to 5

The following facts in relation to copper-plating will prove of value. *The electro chemical equivalent*, or the amount of metal deposited by one ampere per second is the basis of this table.



SIMPLE PLATING CELL.

COPPER.

			Weight in Grammes.	
Current 1	ampere deposits		.000326	per second
" 1	"	"	.01957	" minute
" 1	"	"	1.17390	" hour
851.8	"	"	1.	kilogramme per hour
386.4	"	"	1	pound per hour.

The further facts worthy of consideration depend upon the extent to which the plating is done for their usefulness. When a great quantity of copper is to be deposited each day the following is a valuable fact to remember:

One hundred pounds of copper deposited in a day of ten laboring hours would require 3,864 amperes of current.

To return to the process and precautions necessary—the material to be plated must be thoroughly free from grease and oil.

A coating of oxide sometimes forms from exposure to the air; both can be removed by using two baths for cleansing, as mentioned below:

Stripping or acid bath.
Cleansing or lye "

(*To be Continued.*)

ONE OF OUR PAST WORKERS.

We are pleased to know that our ex-editor, Mr. Thos. R. Taltavall, has joined the editorial staff of *The Electrical World*. We wish him every success. Evidently our paper fits men for the highest vocations.

ONE HUNDRED AND FIFTY THOUSAND DOLLARS.

WASHINGTON, D. C., March 17, 1896.

The Post-Office Appropriation Bill, as passed by the House, carries with it an appropriation of one hundred and fifty thousand dollars to be used for the transportation of mail by electric and cable systems, with the following regulations and restrictions :

The Postmaster-General is authorized and directed to adjust the compensation to be paid for the transportation of mails on electric car and cable routes upon the conditions and at the rates hereinafter mentioned.

For full railway post-office cars, which are to be used for postal purposes only, to be operated independently of other cars, and to be not less than sixteen feet, inside measurement, the compensation shall not exceed twelve cents per mile travelled.

For compartment post-office cars, to be operated independently of other cars, the compartment to be used for postal purposes to be not less than ten feet in length, inside measurement, and full width of car, or not less than thirteen feet in length and five feet in width, inside measurement, not to exceed seven cents per mile travelled.

For trailer post-office cars, to be run with regular passenger cars, and to provide space for postal purposes not less than sixteen feet in length, inside measurement, and full width of car, not to exceed five cents per mile travelled; or if under sixteen feet, but not less than twelve feet in length, inside measurement, and full width of car, not to exceed four cents per mile travelled.

All of the post-office cars mentioned in the preceding sections shall be of such style and character, furnished in such manner, run with such frequency and speed, and on such schedules as shall be required by the Postmaster-General, and shall be constructed, fitted up with the necessary furniture and fixtures for the proper handling and distribution of mail, maintained, heated, and lighted by gas or electricity, by and at the expense of the railroad companies; and clerks in charge of the mail shall be carried without additional charge therefor.

When post-office car service shall be authorized on any route by the Postmaster-General, as provided herein, no additional compensation shall be allowed on account of the weight of the mail carried on said route; and it shall be the duty of the railroad company operating said route to carry additional mail in closed pouches, in charge of its employees, on other than the post-office cars, when so directed by the proper officer of the post-office department, without further compensation.

For routes on which no post-office cars are authorized by the Postmaster-General, but on which mails are carried in closed pouches in charge of employees of the railroad company, the pay per mile of route per annum on routes carrying their whole length an average weight of mails per day of eight hundred pounds or less shall not be to exceed $75; over eight hundred pounds, the rates to be as provided by existing law for transportation of mails on railroad routes; the average weight to be ascertained as provided by law; the service to be performed with such frequency and speed and by such a schedule as will be satisfactory to the Postmaster-General.

The compensation herein provided shall apply only to electric and cable routes not exceeding twenty miles in length. The compensation for carrying the mails on electric and cable car routes longer than twenty miles to be as provided by existing law for the transportation of mails on steam railroad routes. And it is further provided in the bill, that all street railway companies carrying mails under the foregoing provisions shall furnish free transportation to letter carriers to and from the post-office and their respective routes, when such distance shall exceed one-half of a mile, as the Postmaster-General may direct.

A. F. Tennille.

ROENTGEN RAYS.

Current Outside of a Wire.—None of the energy of a current travels along the wire, but it enters into it from the surrounding non-conductor, and as soon as it enters it begins to be transformed into heat, the amount crossing succesive layers of the wire decreasing till by the time the centre is reached, where there is no magnetic force, it has all been transformed into heat.

A Wire Like an Exhausted Tube.—The tendency of recent views is that electrical energy is conveyed through the electro-magnetic medium or ether, and that the function of the wire is to localize the direction or *concentrate* the flow in a particular path, and to afford a *sink* or place in which energy can be dissipated.

When we see an electric car, or motor, or lamp worked from a distant dynamo, these notions invite us to consider the whole of that energy, even if it be thousands of horse-power per hour, as conveyed through the ether or magnetic medium, and *the conductor as a kind of exhaust valve*, which permits energy to be continually supplied to the dielectric.

Magnetic Waves from a Battery.—A battery producing heat in a conducting wire illustrates the fact that the potential energy of the chemical combinations in the battery causes energy to be radiated out along certain lines; the means of conveyance being the electromagnetic medium; thus energy flows into the wire at all points and is there re-transformed into heat or light.

The Energy of a Condenser.—Before a condenser is discharged the energy resides in the dielectric between the plates. This fact appealed very strongly to Benjamin Franklin in his experiments with a Leyden jar having movable coatings. He found that when the jar was charged the coatings could be replaced by new ones and the discharge still occur.

Photographing by Heat Waves.—It must be understood that a sensitive plate exposed continually to the influence of dark-heat waves will ultimately become affected. With the plate still covered, the same would occur with light waves such as proceed from the sun, the arc light, acetylene or even illuminating gas. A fair test is to expose an aluminum disk to their action. Cathode rays penetrate this metal, and though not pronounced as an absolute fact, it is highly probable that these other radiations will fail to display their partial identity.

Carbon Shortens the Wave Length.—In the case of an arc or glow lamp worked by an alternating current, we have still further the result that the energy which moves in on the carbon is returned again, with no other change than that of *a shortened wave length*, and the carbon filament performs the same kind of change of the electromagnetic radiation as is performed when we heat a bit of platinum foil to vivid incandescence in a focus of dark heat.

The Dynamo a Source of Radiant Energy.—The action of the dynamo when at work consists of alternately inserting into and withdrawing a bundle of lines of magnetic induction from a portion of this enveloped area or loop. The insertion of these lines of force causes an electromagnetic disturbance which travels away through the enclosed dielectric in the form of some strain or displacement in its most generalized sense. In reaching the surface of the enclosing conductor this wave begins to soak into it, the electromagnetic energy at the same time dissipating itself in it in the form of heat. By a suitable arrangement of the resistances and surfaces of various portions of the circuit, we are able to localize the principal place of transformation and to control its rate so as to compel this transformation of energy to take place at a certain rate in a limited portion of the conductor.

Energy is then sent out thence again in a radiant form, partly in the form of ether waves capable of exciting the retina of the eye, but very largely in the form of dark heat. The ether, or electromagnetic medium, is therefore the vehicle by which the energy is carried to the lamp, and conveyed away from it in an altered form, and whatever be the translating device employed, the ether is the seat of the hidden operations, which are really the fundamental ones, and the visible apparatus only the contrivances which, by the nature of the energy, transformation is determined and its place defined.—(*Extracts from Fleming.*)

Huntington, Pa.—Owing to the electric light company refusing to furnish light to that place, Huntington is in darkness.

ROENTGEN RAYS "ANODIC," NOT "CATHODIC."

BY ELIHU THOMSON.

Since the first publications concerning Roentgen's discovery of the rays emanating from a Crookes tube it seems to have been assumed by most investigators that said rays have some relation to the radiant matter of Crookes which is a phenomenon of the cathodic terminal.

Others, again, have considered that the rays discovered by Roentgen were produced at the glass surface, or during transmission through the glass, and as a consequence of the impingement of the cathode rays upon the glass, causing its fluorescence. Prof. J. J. Thomson is reported to have exposed photographic plates to the cathode rays or radiant matter within the tube without having produced any effect which could be brought out by development.

Very recently Prof. H. A. Rowland has pointed out the fact that the Roentgen rays are emitted from the anode and not from the cathode, and this view coming from so high an authority is in itself an indication of its probable

Elihu Thomson

truth. The writer, personally, had been led to suspect that the rays were anodic, not cathodic; for it was found that the rays when traced to their source within the tube, by methods which have been published by him, came from that terminal which during the passage of the spark discharges could not have been the cathode. Using a Wimshurst machine it was easy to determine the polarities. Furthermore, the best effects on the photographic plates were produced opposite that portion of the glass which became strongly fluorescent. This fluorescence, however, could not have been produced from the cathode, as the rays normal to the cathode surface would not have impinged there.

By constructing a dark tube with a screen of barium platino-cyanide the writer was able to submit to examination the various forms of Crookes' tubes in his possession. Some of these, though fluorescing strongly by the cathode rays, gave at no position with respect to the screen tube any indications of the emission of Roentgen rays, while some gave feeble indications near the anode, and in exceptional instances a strong effect was noted, not from those parts where the cathode rays made the glass fluorescent, but from other parts opposite the anode.

The crucial test was made by placing a small patch of opaque metal upon the side of a tube opposite the anode. It was found that when the anode, the patch, and the fluorescent screen were in line, no fluorescence was obtained, although the screen was fully exposed, as it were, to the cathode.

It may be mentioned here that the fluorescent screen tube forms a most valuable means for rapidly exploring the field of the Crookes tube and so determining whether it can be used as a source of Roentgen rays or not. It also enables one to determine the best direction in which the rays are emitted, and is much quicker than the sensitive plate for such observations.

In one of the tubes examined the effects appeared to indicate that the Roentgen or anode rays are deflected or turned aside sharply when they arrive near the cathode terminal, which in this case was a bent sheet of aluminum. This effect is worthy of further investigation.

The writer also personally exhausted a Crookes tube by a Sprengel pump, watching with the fluorescent screen tube for the first indications of Roentgen rays. It was found that when that degree of exhaustion was reached which gave an excellent exhibition of radiant matter from the cathode, and even clear-cut shadows of objects by such rays as evidenced by the brilliant fluorescence of the glass where the rays impinged, there still was no indication of Roentgen rays even when the fluorescent screen in its dark tube was not more than a quarter of an inch from the strongly fluorescing glass wall. As, however, the exhaustion improved the indications of Roentgen rays began to be manifest, and at last they became quite pronounced. These rays seemed to originate at the anode, and although they may possibly be deflected in the vicinity of the cathode, they otherwise proceed in straight lines from the anode and through the glass, causing fluorescence of the latter in much the same way to all appearances as the cathode rays, except that while the cathode ray fluorescence is fairly stable or stationary, the anode ray fluorescence flits about or changes its direction with every discharge, scarcely if ever repeating the same pattern of fluorescent patches on the walls of the tube or bulb.

The following summary of effects is apparently in accord with the facts:

First—Cathode rays are produced at lower exhaustions than give rise to anode rays that reach the glass.

Second—Anode rays are best produced at the very highest exhaustions short of insulation.

Third—Anode rays pass out through the glass of the Crookes tube; cathode rays (radiant matter) apparently do not.

Fourth—Both anode and cathode rays cause fluorescence of the glass and possibly of many other substances.

It is not known whether anode rays cause fluorescence of any substances that are not so affected by cathode rays, and vice versa.

Fifth—Anode rays are erratic in distribution from the anode surface. Cathode rays are of nearly uniform distribution, and leave the cathode surface at right angles.

Sixth—Anode rays are not capable of being deflected by a magnet; at least, not after they have passed the glass. Cathode rays appear to be so deflected within the tube and after they have traversed an aluminum window. (Lenard.)

Seventh—Diminishing the size of the anode concentrates and focalizes the rays emanating therefrom. Shaping the cathode into a concave cup gives rise to a focus of cathode rays by virtue of their direction being normal to the cathode surface.

The question suggests itself—can anode rays reach and pass through a thin aluminum sheet which is at the same moment the cathode for the discharge? And, on the other hand, can cathode rays traverse the anode if of a thin aluminum sheet? It is probable that opacity of the opposite terminal would be noted in these cases, and possibly, deflection of the rays in each case near the terminal of opposite polarity to that emitting the rays.

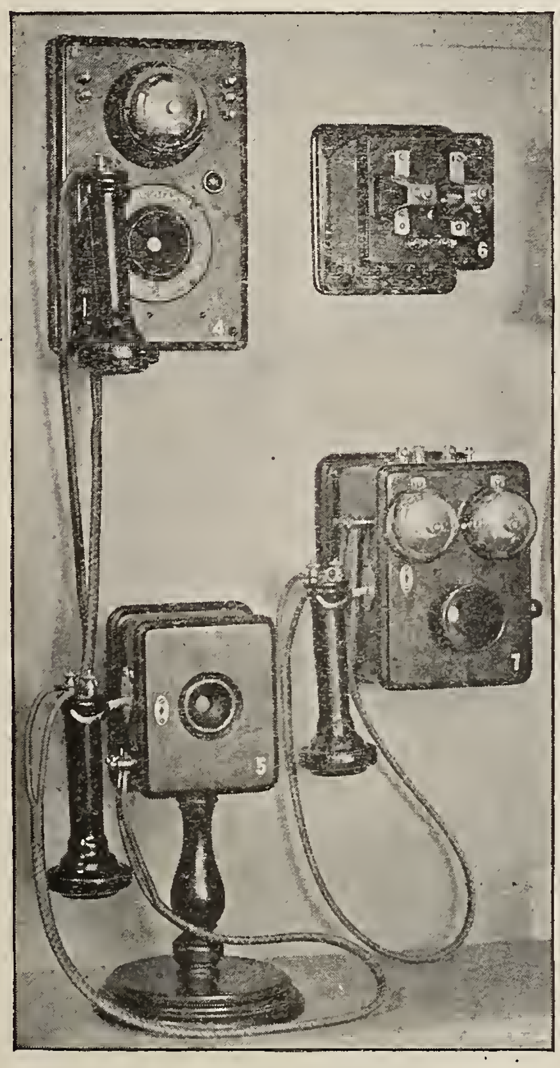
The significance of Roentgen's discovery is greatly enhanced and the scientific interest therein multiplied when it is recognized that there may be an entirely unsuspected radiation, not from the cathode but from the anode; that both electrodes may emit radiations characteristic of the electric states of the terminals, and that such radiations are widely different from each other and from other known radiations. If the anode rays are longitudinal waves in the ether, what are the cathode rays? If the cathode rays are longitudinal, what are those of the anode? Is it possible that neither of them are longitudinal vibrations of the ether, and that one must now look for an explanation of the two radiations which shall be alike, and yet not alike?

In these radiations there may be again a manifestation of differences between positive and negative electrical states, which differences seem to be in some way impressed on the radiations set up in the neighborhood of the poles. There undoubtedly is a great field for research opened by the discovery of Roentgen, and it is fortunate for science that the Crookes tube he experimented with possessed a high enough vacuum to cause it to give anodic as well as cathodic rays.

GOOD TELEPHONES.

The Crandall Mfg. Co., 29 Bank street, Philadelphia, Pa., are engaging in a large business of telephones. Their instruments are cheap, reliable and well finished. They can supply all kinds of electrical goods, but their specialty of telephone equipments have brought them into prominence.

It is no easy matter to turn out a clear-voiced 'phone,



CRANDALL TELEPHONE OUTFITS.

one in which the articulation is distinct, yet they have done so, and their transmitters and receivers are perfectly competent to match the best on the market. They have desk as well as wall sets, thus making it an easy matter of choice for men of business. In the illustration we show the combination sets and style of their goods.

CANADIAN LETTER.

BY OUR MONTREAL CORRESPONDENT.

Electrical News.

St. John's, N. F.—It is said that St. John's, Newfoundland, is to have an electric street railway.

Toronto, Ont.—The Royal Electric Co. are extending their premises on York street, Toronto, Ont.

Durham, Ont.—*The Grey Review* says that J. H. Kilmer has secured enough subscribers in Durham to justify him in putting in an electric lighting plant.

Newmarket, Ont.—The Town Council of Newmarket, Ont., has decided to raise $9,000 by way of loan to operate an electric light plant, which will belong to the town.

Pakenham, Ont.—A Pakenham, Ont., gentleman who has gone into the electric light business, is contemplating the extension of his system to Arnprior, says an exchange.

Westport, Ont.—W. H. Fredenburg will put in an electric light plant in Westport, Leeds County, Ont., provided the town will guarantee him two hundred lights at two and a half cents per light.

Kingston, Ont.—The city council of Kingston, Ont., are in favor of municipal ownership of lighting plants, as the replies to the enquiries sent out by them to cities all over the continent point in that direction.

Hamilton, Ont.—Messrs. John M. Lake and M. Hopkins are the promoters of an electric railway from Hamilton via Hall's Corners, York and Indiana to Cayuga or Dunnville, with a spur to Caledonia.

Hamilton, Ont.—Mr. John Patterson, who is promoting the radial railway from Hamilton to Burlington, affirms that the road will be in operation by the first of June.

New Corporations.

Harrisburg, Pa.—The Hagerstown Railway Co. was incorporated at Harrisburg. The object is to operate a street railway in Hagerstown and to Williamsport, Funkstown and other points in the county. Capital, $200,000. Incorporators, Christian W. Lynch, William Jennings and J. A. Herman of Harrisburg, Pa.

Elkton, Md.—The Rising Sun, North East and Elk River Electric Railroad of Cecil County has been chartered. Incorporators, James Mallen, Andrew Anderson, A. L. and E. L. Duyskinck, George W. Cosden, W. L. Mearns and M. E. Kirk. Capital stock is $30,000.

Oakland, Cal.—The Oakland & Livermore Valley Road Co., incorporated by E. P. Vandercook, George D. Metcalf, A. D. Wilson and others. The capital stock is $3,000,000. The incorporators will build a road from Oakland to Livermore, and thence northerly to the boundary line between the counties of Alameda and San Joaquin, with branches to adjacent towns. The total length of the road is estimated at 45 miles.

Cripple Creek, Col.—The Electric Tramway & Tunnel Co. C. H. Rice is president, and the capital stock is $2,000,000.

Sidney, N. Y.—Orlecut Electric Light and Power Co., to operate in Sidney and Unadilla. Capital, $25,000; Directors, H. McGonegal, James C. Holden, 32 Liberty street, New York city; Walter F. Randall, of Syracuse; Fred C. Ward, of Franklin, and H. S. Sewell of Walton.

Oshkosh, Wis.—The incorporation of the Oshkosh, Omro and Berlin Electric Railway Co. has been completed and officers elected as follows: President, Leander Choate; vice-president, William Dichman; secretary and treasurer, A. Kellogg.

Baltimore, Md.—Equitable Subway Co. has made application for a charter, with a capital stock of $1,000,000, for the purpose of constructing subways for electrical wires. Incorporators, R. Ramsey, E. P. Hill, W. Y. Perot, J. H. Keene and others.

Wheeling, W. Va.—I. H. Dillon and others have incorporated the Dillon, Wheat & Hancher Electric Co. Capital stock, $25,000.

Possible Contracts.

Fall River, Mass.—John B. Swift and Philip J. Farley went to New York to consult an architect on the plans for a new theatre to be erected, which will be ready this week. It is estimated that the cost of the structure will be from $75,000 to $100,000.

Far Rockaway, L. I., N. Y.—At the last meeting of the Board of Trustees of Far Rockaway, a franchise was granted to the Long Island Electric Railroad Co. to operate a street railroad in the village. This gives the company a continuous right of way from East New York to Far Rockaway through Jamaica, and work will be commenced as soon as the weather will permit.

St. Catharines, Ont.—The bill incorporating the Lincoln Electric Radial Railway Company hes passed the Railway Committee of the Ontario Parliament.

New York City.—A one, two and three-story brick bicycle academy, etc., is to be erected by Darius Tallman, 102 West 93d street, on 93d street, north-east corner of Boulevard, at a cost of $25,000.

Hartford, Conn.—Architects Cady, Berg & See, of New York City, are drawing plans for a $100,000 addition to be made to the Hartford Fire Insurance Co.'s building at Hartford.

Baltimore, Md.—Baltimore proposes to issue a $1,000,000 loan for electrical subways.

Nfw York City.—Herrmann is contemplating the erection of a $350,000 theatre in New York City.

New York City.—Ralph S. Townsend is making plans for Flake & Dowling for a twelve-story brick and stone store and office building at 95 and 97 Liberty street, at a cost of $260,000.

The Livingston estate is having plans prepared by Ralph Townsend, 1298 Broadway, for a twelve-story brick and stone store building (and office), at a cost of $180,000, at 12 to 16 John street.

Kansas City, Mo.—Plans have been completed for the electric power-house of the Metropolitan Railway Co.; equipment to include sixteen boilers, four engines and dynamos to generate 5,000 H. P.

Ballston, N. Y.—The Ballston Terminal Railroad Co. has been incorporated with a capital of $300,000. Its purpose is to construct a street surface railroad, to be operated by electricity, ten miles in length from the D. & H. tracks on Butte street to the westerly line of the village at or near the north bank of Kayanderasseras Creek, and thence to the bridge spanning the creek, south of the village of Middle Grove. Directors: Alfred N. Chandler, Arthur S. Chandler, John H. Nabbit, of Philadelphia; Charles H. Stanton, of Brooklyn, and Arthur B. Paine, Frank Jones and John H. Morris, of Ballston.

Telephone Notes.

Fenton, Mich.—A stock company is being formed at Fenton for the purpose of establishing a telephone exchange.

Crisfield, Md.—The Town Commissioners, at their regular meeting, gave a franchise to the Crisfield Telephone Exchange for erecting poles and wires, will at once erect lines to Ward's Crossing.

Honesdale, Pa.—The Delaware & Hudson Canal Co. is constructing a telephone line between Honesdale and Carbondale.

Alexander, Ia.—Alexander is to be connected by telephone with the surrounding towns.

Gadsden, Ala.—Address R. L. Adams, manager, regarding the new telephone system being constructed.

Dallas, Tex.—It is reported that C. Glidden, Lowell, Mass., treasurer of the Southwestern Telephone and Telegraph Co., has stated that the company expects to connect Clarksville and Texarkana with Malvern, Ark., next fall—a distance of 162 miles. This gives connection as far north as Little Rock, from whence the system will be extended to Memphis, a distance of 156 miles.

NEW TELEPHONE COMPANIES.

Eldora, Ia.—The Hardin County Telephone Co. filed articles of incorporation. Incorporators, C. F. Albrook, J. D. Newcomer, C. E. Greef, W. S. Porter and C. F. Bennet. Capital, $25,000.

Montclair, N. J.—A new telephone company has filed its incorporation papers under the head of the Montclair and Bloomfield Telephone Co. Incorporators, Eugene W. Davis, of New York; George B. Harrison, of Caldwell; and I. Seymour Crane, Alfred S. Badgley, James Henderson and William M. Taylor of Montclair.

Emden, Mo.—A company is being formed to establish telephone system from Hunnewell to Oak Dale, Emden and Shelbyville. Address Henry Brown.

See Telephone Patents on Page 155 of Electrical Patents.

FOR UPTOWN TELEPHONE SUBSCRIBERS.

An uptown branch of the Contract Department of the Metropolitan Telephone and Telegraph Company has been established at 113 West 38th street (one door from Broadway), where all business relating to the supply of telephone service can be transacted as readily as at the main office at 18 Cortlandt street. There are 14,000 telephone stations in New York City. Metallic Circuit Service, Rapid, Efficient, Permanent can be had from $75 a year.

CANADIAN LETTER.

BY OUR MONTREAL CORRESPONDENT.

Electric Railways.

St. Thomas, Ont.—St. Thomas, Ont., is opposed to the building of an electric road from London to Port Stanley.

Guelph, Ont.—Geo. Sleeman, of Guelph, Ont., will build another mile of the electric road in that town before May 20th.

Bear River, N. S.—It is reported that the Bear River, N. S., Electric Co. are to extend the Bear River light system to Digby, N. S.

Halifax, N. S.—Halifax, N. S., has its electric street-railway in operation. A number of minor accidents marked the advent of the trolley.

Ottawa, Ont.—Hon. Jno. Haggart announces that the Dominion Government will leave electric railways to provincial control in the future.

Arnprior, Ont.—A committee of the town council of Amprior, Ont., will deliberate on the purchase by the town of the electric plant there.

Thorold, Ont.—The Thorold, Ont., street railway is to be practically rebuilt this spring. The trolley system will be put in and the line laid with T rails.

Montreal, Que.—Surveys are being made for the new line of the Montreal Park and Island Railway from the big bridge at Back River to St. Vincent de Paul.

Niagara Falls, Ont.—The council of Niagara Falls, Ont., is considering the proposed electric street car franchise which the N. F., W. P. & C. Tramway Company asks for.

QUEBEC, QUE.—H. J. Beemer is making arrangements with some capitalists from the United States for the immediate pushing of work on the new Quebec electric railway.

HALIFAX, N. S.—Rhodes, Curry & Co., Ltd., Amherst, N. S., have just turned out the first two of the fourteen street cars they are building for the Halifax Electric Street Railway.

HAMILTON, ONT.—It is said that the International Radial Railway Co. has decided upon a route from Hamilton to Freelton and Guelph. Both Waterdown and Dundas will be given the go-by.

HAMILTON, ONT.—The Hamilton and Dundas Railway Co. is desirous of changing from steam to electric traction but fears to lose its Sunday trains by thus placing itself under the Ontario Act.

CAMPBELLFORD, ONT.—Some of the Campbellford, Ont., people are trying to organize a company to buy an electric road from Campbellford through Warkworth and Hastings to Norwood, and return by Havelock.

PERTH, ONT.—The promoters of the electric railway between Perth and Lanark, who have been voted $10,000 by the village of Lanark, intend asking Perth council to submit a by-law for $5,000 bonus.

ST. THOMAS, ONT.—The city council of St. Thomas, Ont., has decided to submit a by-law to the ratepayers for the issue of debentures to build a street lighting and commercial electric light plant, at an estimated cost of $50,000.

HAMILTON, ONT.—The following are directors of the Hamilton Street Railway Company: B. E. Charlton, president; George E. Tuckett, E. Martin, Q. C.; W. Gibson, M. P.; J. B. Griffith, William Harris and F. W. Fearman.

OTTAWA, ONT.—W. Dale Harris, general manager of the P. P. J. Railway, says that if the C. P. R. sell their Aylmer branch to the Hull Electric Co. the P. P. J. Railway will this summer build a line from Aylmer to Hull, and that the extension of the Q & G. Railway from Wright to Desert will also go on this summer.

VICTORIA, B. C.—The Victoria, B. C., Electric Railway is to be sold at auction on April 11, if not sold earlier by private sale by the bondholders. It is expected that they will buy in the road themselves and run it. The prospects for the unsecured creditors are not bright.

LACHINE, QUE.—The town council of Lachine, Que., will allow the Montreal Park and Island Railway running privileges in the town, with exemption from taxation for thirty years. It is contemplated to build this line at once and to extend the Outremont line to St. Laurent during the summer.

J. ALCIDE CHAUSSE.

New York Notes.

Watson & Stillman have received an order for the building of fifteen draw benches for bicycle tube manufacture, each of them with a stroke of 18 feet.

The McIntire Co. are doing a rushing business in their fuse wire, fuse links and strips. Their patent connectors are being called for more rapidly than ever, and this year's business promises to be beyond their expectations. They are still at 15 Franklin street, Newark, N. J.

Mr. Jones, secretary, Law Battery Co., 39 Cortlandt street, N. Y., was met by the writer on his return from an extensive business trip and reports a good trade in their goods.

Mr. W. C. Armstrong, formerly associated with Mr. Bramhall in the Standard Thermometer Co., retains his position with H. D. Bayne & Co., 39 Cortlandt street, N. Y., the general agents for the Standard Thermometer Co. Mr. Armstrong is selling agent for H. D. Bayne & Co., and is a competent electrical engineer and thoroughly understands the installation of incandescent and all low tension apparatus.

C. A. Bramhall, formerly of the Standard Thermometer Co., 39 Cortlandt street, N. Y., has been appointed New York manager for Diehl & Co., manufacturers of ceiling fans, motors, arc lamps, etc. Mr. Bramhall is well known to the trade and buyers generally, as he has represented the above line of productions for a number of years, and is fully qualified to look after the interests of his present company. They are to be congratulated for securing so industrious and ambitious a representative.

Frank S. Allen, manufacturer of portable electric propellers, 136 Liberty street, N. Y., reports a large and flourishing business. They have orders far ahead for propellers of the style shown in their advertisement on page VI of this journal. A new and useful article like theirs can't help selling like pancakes. For summer use on lakes and rivers it will prove a delightful source of amusement.

The '96 model XNTRIC switch manufactured by the Paiste Co. is selling very rapidly. Also the Paiste porcelain circuit board, built for any number of circuits. Mr. H. M. Shaw, of 126 Liberty street, has charge of these specialities.

The Wirt dynamo brush sold by H. M. Shaw, of the above address, is one of the best known in the trade. The Paiste Co., of Philadelphia, manufacture this article. It is a great saving to the commutator.

An excellent lightning arrester manufactured by H. M. Shaw, of 126 Liberty street, is being put to extensive use by railway and central station managers. Mr. Shaw has met with considerable success in handling specialties, and his own arrester is included.

The Kabot Electric Co. has been compelled to enlarge both shops and offices at 72 and 74 Fulton street, N. Y., so as to increase their capacity for the manufacture of specialties. Their battery seems to meet with success, which is undeniably due to its high standard and efficiency.

The Marine Gas Engine, manufactured by L. J. Wing & Co., is coming into general use of late, especially in conjunction with marine electric lighting and ventilation. Their perfected system of igniting the gas in the cylinder by a spark generated by several batteries is one of its best features. Mr. Wing informed the writer of the fact that their engine is being extensively used now in running dynamos, its speed being so uniform that no fluctuation whatever is visible in the lamps. This was one of the most difficult mechanical problems, which till now retarded the general use of the gas engine, in electric lighting, but it seems to have been solved by above company.

W. T. HUNT.

ELECTRICAL and STREET RAILWAY PATENTS

Issued March 17, 1896.

556,342. Electric-Motor Rheostat. Thomas J. Fay, New York, N. Y. Filed Dec. 12, 1895.

556,359. System of Multiphase Distribution. Ralph D. Mershon, Pittsburgh, Pa. Filed Apr. 11, 1895.

556,362. Electrical Connector for Arc Lights. John J. McGill, Thorold, Canada, assignor of one-half to James Battle, same place. Filed Jan. 15, 1896.

556,381. Car-Fender. Theobald Stein, Philadelphia, Pa., assignor of one-fourth to Louis Goos, same place. Filed Dec. 3, 1895.

556,384. Street-Car Fender. Conover A. Thomas, Philadelphia, Pa., assignor of two-thirds to Frank Schoener, same place. Filed Aug. 2, 1895.

556,386. Electrical Gas-Cock. Harry L. Tyler, Corning, N. Y. Filed June 20, 1895.

556,408. Rheostat. Thomas J. Fay, Brooklyn, N. Y., assignor to the C. & C. Electric Company, New Jersey. Filed Dec, 19, 1895.

556,410. Car-Fender. Mahlon Fulton, Philadelphia, Pa. Filed Feb. 1, 1895.

556,414. Electric Hub-Welding Machine. Charles E. Harthan, Lynn, Mass. Filed June 20, 1891.

556,425. Electrical Registering-Instrument. Hermann Lemp, Lynn, Mass., assignor to the Thomson Electric Welding Company, of Maine. Filed Mar. 12, 1891.

556,426. Electric Metal-Working Apparatus. Hermann Lemp and Warren B. Lewis, Lynn, Mass., assignors to the Thomson Electric Welding Company, of Maine. Filed Apr. 23, 1891.

556,428. Electric Programme-Clock. John P. Luxmore, Chicago, Ill. Filed Nov. 14, 1894.

556,435. Electric Elevator. John Parkinson, Thomas M. Martin, and Calvin C. Bowen, Los Angeles, Cal., assignors to the Pacific Elevator Company, same place. Filed Feb. 7, 1895.

556,437. Electric-Arc Lamp. George C. Pyle, Indianapolis, Ind., assignor of one-half to Frank H. Ewers, same place. Filed May 2, 1895.

556,444. Automatic Car-Fender. George C. Straub, William J. Straub, and Frank A. Gestner, Reading, Pa. Filed Sept. 20, 1895.

556,479. Electric-Arc Lamp. Thomas Spencer, Philadelphia, Pa. Filed July 1, 1895.

556,488. Motor-Suspension. Norman C. Bassett, Lynn, Mass., assignor to the General Electric Company, of New York. Filed Nov. 27, 1895.

556,496. Telephone. Cleaveland F. Dunderdale, Chicago, Ill., assignor to the Automatic Long Distance Telephone Company, of Illinois. Filed May 24, 1895.

556,502. Electric Drill. Max Hebgen, Butte, assignor of one-half to H. W. Turner, Silver Bow, Mont. Filed July 16, 1895.

556,510. Electric Switch. Norman Marshall, Boston, Mass. Filed Dec. 14, 1895.

556,516. Electric-Railway System Byron E. Osborn, Auburn, N. Y. Filed Sept. 3, 1895.

556,524. Electric Heater. James E. Williamson, Charles E. Collins, and John B. Graham, Allegheny, Pa. Filed Feb. 9, 1894.

556,544. Battery Connection. Milton M. Kohn, Chicago, Ill. Filed July 29, 1895.

556,553. Railroad-Crossing Signal. Richard O'Toole, Thurmont, Md. Filed Feb. 20, 1895. Renewed Feb. 15, 1896.

556,602. Underground Conductor for Electric Railways. George Westinghouse, Jr., Pittsburgh, Pa. Filed Jan. 6, 1894.

556,609. Telephone Switchboard. Isaac Anderson, Saginaw, Mich., assignor of three eighths to John Dodds, Dayton, Ohio, and Robt. W. Hutchinsen, Marcellus, Mich. Filed July 8, 1895.

556,617. Electro-therapeutic Apparatus. William Carter, Louisville, Ky. Filed Jan. 29, 1896. Serial No. 577,277.

556,619. Car-Fender. Augustin M. Chavez, Mexico, Mex. Filed June 27, 1895.

556,626. Electric Furnace. Adam C. Girard and Ernest A. G. Street, Paris, France. Filed May 24, 1895. Patented in France May 25, 1893, No. 230.341; in England July 8, 1893, No. 13,340; in Germany, Aug. 2, 1893, No. 81,479; in Austria-Hungary Aug. 2, 1893, No. 41,930 and 65,879; in Belgium Sept. 9, 1893, No. 103,309; in Switzerland Sept 14, 1893, No. 7,460 and 7,562; in Italy Sept. 30, 1893, No. 267, and in Spain Oct. 27, 1893, No. 14,950.

556,646. Device for Detecting Short Circuits. Charles F. Scott, Pittsburgh, and Charles E. Skinner, Allegheny, assignors to the Westinghouse Electric and Manufacturing Company, Pittsburgh, Pa. Filed Dec. 31, 1892.

556,654. Electric Locomotive. Thomas E. Adams, Cleveland, Ohio. Filed Sept. 5, 1894.

556,660. Secondary Voltaic Battery. William A. B. Buckland, London, England. Filed July 15, 1895. Patented in England July 10, 1894, No. 13,363; in France Mar. 28, 1895, No 245,999; in Belgium Mar. 30, 1895, No. 114,-832; in Switzerland Apr. 8, 1895, No. 10,093; in Italy May 7, 1895, LXXV, 464; in Spain June 25, 1895, No. 17,244, and in Canada Aug. 6, 1895, No. 49,639.

559.670. Block-Signal Telegraph. Claude M. Grace, Philadelphia, Pa., assignor of one-half to Arthur E. Bragg, same place. Filed Sept. 10. 1895.

556,672. Safety Guard for Street-Cars. Patrick F. Haran, Scranton, Pa. Filed Aug. 26, 1895.

556,693. Electric Lamp. Charles E. Quimby, New York, N. Y. Filed Aug. 18, 1893.

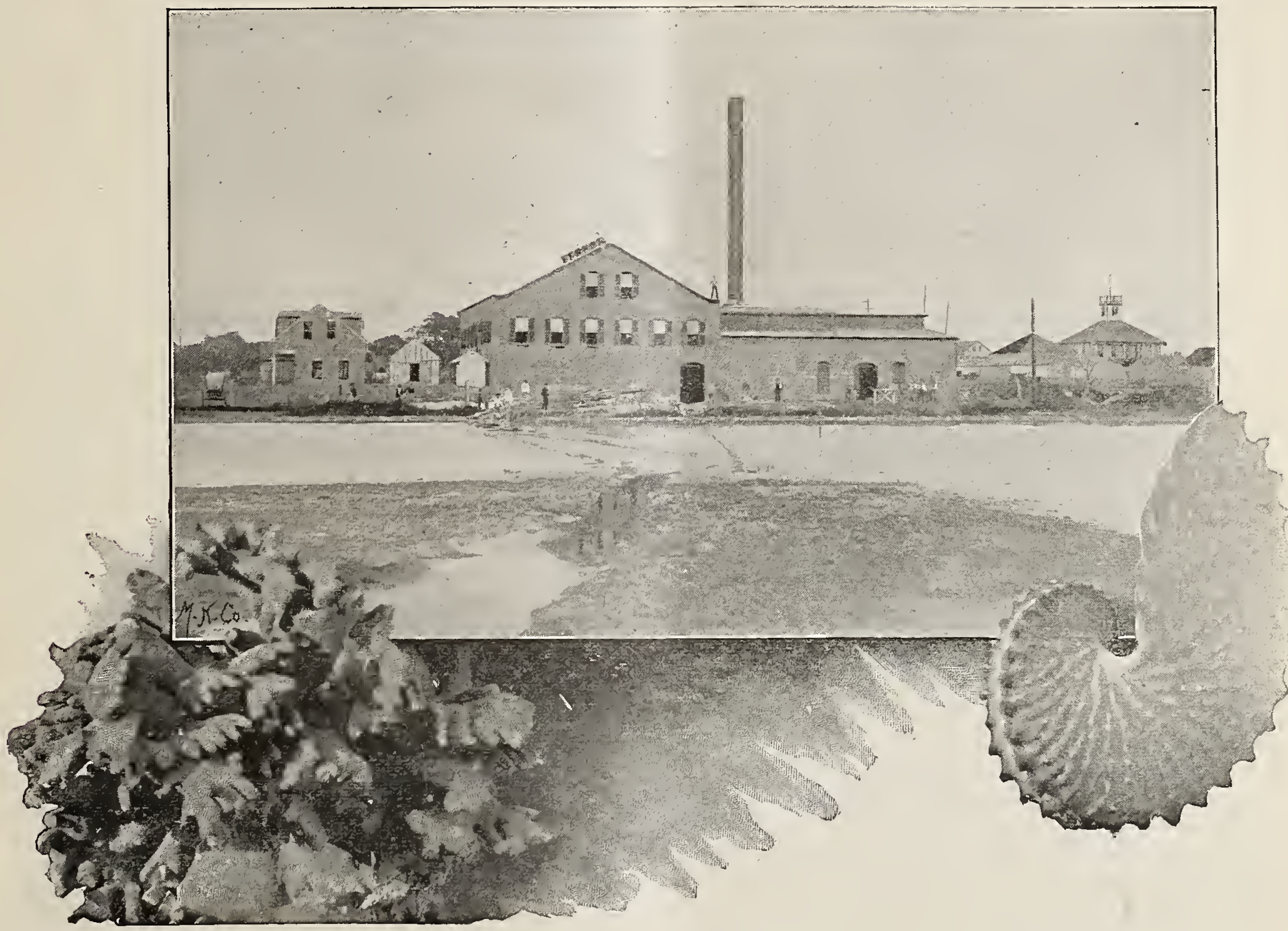
556,708. Portable Faradic Battery. John E. Unger, New York, N. Y., assignor to Jacques Levy, same place. Filed Feb. 6, 1896.

556,712. Sand-Box for Electric or other Cars. Charles H. Cox, Haverhill, Mass., assignor of one-half to S. Porter Gardner, same place. Filed Dec. 17, 1895.

556,718. Electrical Apparatus for Drilling Wells, Tunnels, &c. Phillip Semmer, Irwin, assignor of one-half to Chas. A. O'Brien, Pittsburgh, Pa. Filed Aug. 16, 1895.

The Electrical Age.

Vol. XVII., No. 14. NEW YORK, APRIL 4, 1896. Whole No. 464



THE ELECTRIC LIGHT IN THE TROPICS.

"Fast fades the glimmering landscape on the sight
And all the world a solemn stillness holds,
Save where the beetle wheels his droning flight
And drowsy tinklings lull the distant folds."

Darkness falls like a cloak in southern latitudes. The charitable touch of twilight is but the beginning of an intense darkness. In the warm, sultry air the struggling oil lamp with its far reaching fragrance reigns supreme.

The sweet smell of flowers, the gleam and flash of the firefly and the murmur and bustle of a town awakening into life and activity are not to be forgotten by the northern visitor.

The state of indolence and unrestrained indulgence is very marked. Life during the day is but a preamble to the animation at night.

The sleepy buzz of innumerable insects and rising tone of a foreign tongue strikes the ear with an overwhelming sense of its utter strangeness and incomparable novelty.

To cast the brilliant gleams of an arc over such a scene would be like visiting the town with the touch of a magic hand. The long-drawn Spanish salutations, the frothy chat of passing friends belie the extreme quiet and lifelessness of the previous hours.

The Spanish descendents that so possess the tropics delight in bright illumination. They revel in the sudden change from darkness to extreme light, and view with great gratification the beginning of all such lighting enterprises.

The larger cities, which boast of places of amusement, can now hope to make their theatres and operas endurable. The arias will ring out with an inspiration that will never more be mistaken for perspiration.

The Island of Cuba is most enterprising in the rise and furtherance of electric lighting.

The sugar plantations are agleam at night with this novel radiance. Under some isolated shed near a group of outhouses may be seen a couple of half-breeds shovelling the crushed sugar cane into the boiler fire and trying their best to keep the pressure steady.

Possibly another, deeply interested in holding a brush on an unfortunate commutator, will also be seen pressing it in place with a stick. This state of affairs may be viewed by any visitor to lands where the applications of science are enthusiastically received, but for lack of skill and care become a source of expense and worry.

The field is wide and the enterprise of competent men would lead them by thrift and industry into veritable Eldorados. The languor inducing climate, the inward and inherent inability to work, has stayed progress in many Spanish-American countries and left the opening wide for the vigorous and intrepid American engineer.

Electric light plants are beginning to be looked upon as a necessity in the South American Republics. The electric railway has introduced itself with remarkable success and it seems that the people are awakening to the fact that they alone are behind in the onward march.

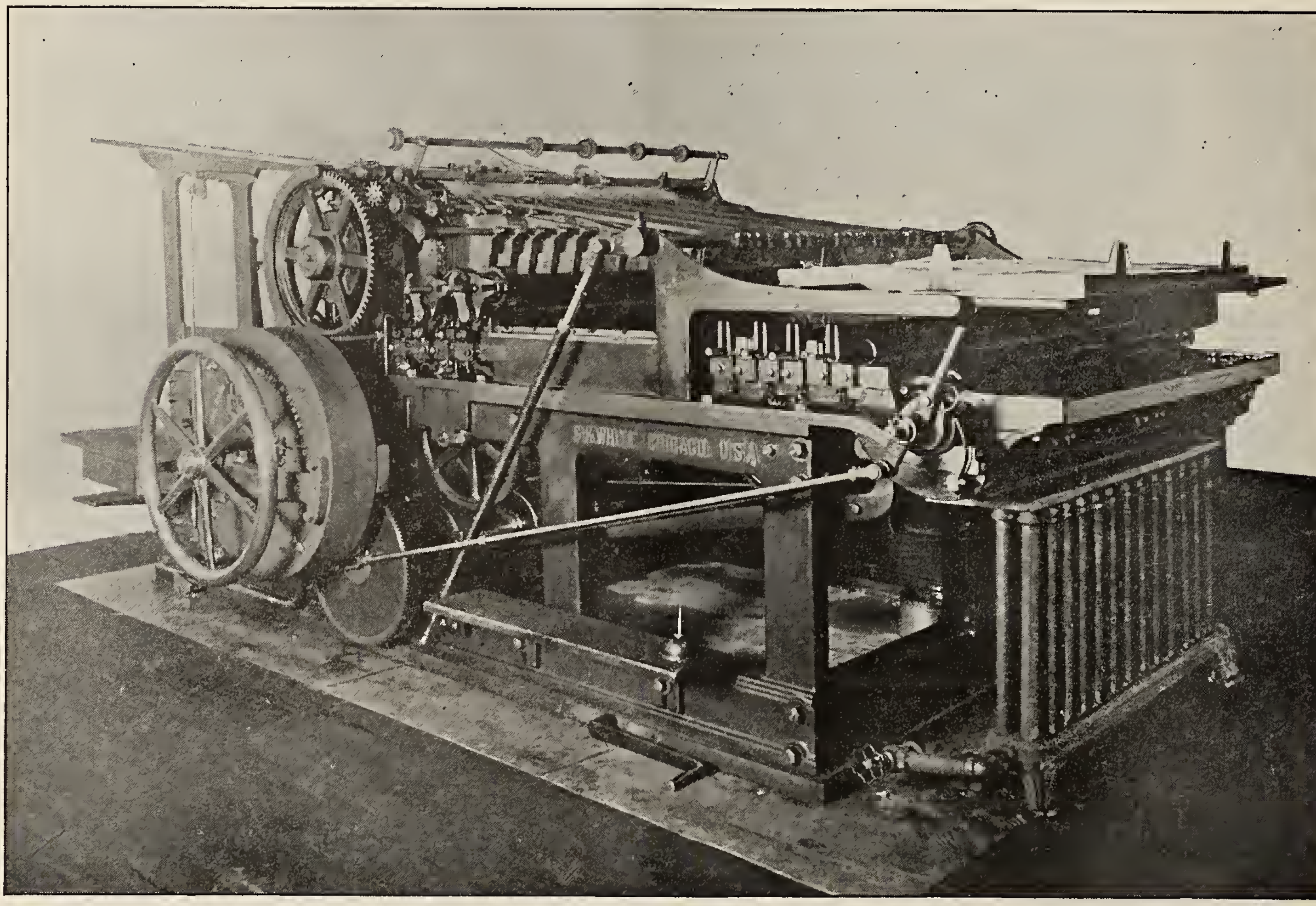
The bad financial condition of some of these localities—their improvident and unprogressive spirit—has been the cause of this dearth of ability; but the tide of change is irresistible, it will overcome their prejudices and struggle with adversity until success has crowned every effort.

DIRECT-CONNECTED MACHINES.

The great convenience of having power directly applied to the machine consuming it has led several companies to build special apparatus for this purpose. The extent to which this idea has been carried out may be realized when it is known that one of our large shops disregard the so-called advantages of belts and connect motors directly to all tools.

There is undoubtedly a great advantage in following this system, as it individualizes each active tool and makes it completely independent of its neighbor. It furthermore economizes in power, meaning no waste when the tool is unused, and only an amount commensurate with the work done when utilized.

The Card Electric Motor and Dynamo Co. have believed in the excellence of this practice and applied one of their motors directly to a printing press, as seen in cut. This is probably the, first attempt in that direction though it will be but the forerunner of many others. The power a press consumes is light when in running operation, yet the starting torque required is very high and calls greatly upon the vitality, if we may term it so, of the motor. The slippage of belts is thus obviated and a new and more efficient method applied. The field for such work is very great, and if a customer can be brought to realize that a special equipment of this sort is ideal in its way and a source of future satisfaction, the first cost will not appeal so strongly to his sentiments, but allow him to weigh in the scales of reason the advantages as well as the expense.



CARD ELECTRIC MOTOR DIRECT-CONNECTED TO CYLINDER PRESS.

A Powerful Discharge.—The reason that the discharge of a powerful induction coil gives rise to oscillatory motion is that, firstly, it charges the terminals to a potential; secondly, it produces a sudden spark in the intervening circuit; and thirdly, as soon as the discharge begins the resistance of the air space is so much reduced as to allow of oscillatory motion being set up.

Mason City, Ia.—The Iowa Union Telegraph Co.'s lines are at once to be extended from this city north to Austin, Minn., and south to Hampton.

A NEW METHOD OF STUDYING THE LIGHT OF ALTERNATING ARC LAMPS.

A paper presented at the 104th Meeting of the American Institute of Electrical Engineers, New York, March 25, 1896.

BY WILLIAM L. PUFFER.

When a direct current of proper volume is caused to pass between the tips of suitable carbons, there is produced the phenomenon called the arc light. Generally the direction of the current flow is such that the upper carbon is the positive, and the lower the negative electrode. In order to produce a quiet and steady arc, the positive carbon may have a soft central core to aid in the formation of the crater from which the greater part of the light is emitted. The negative carbon may be cored or solid.

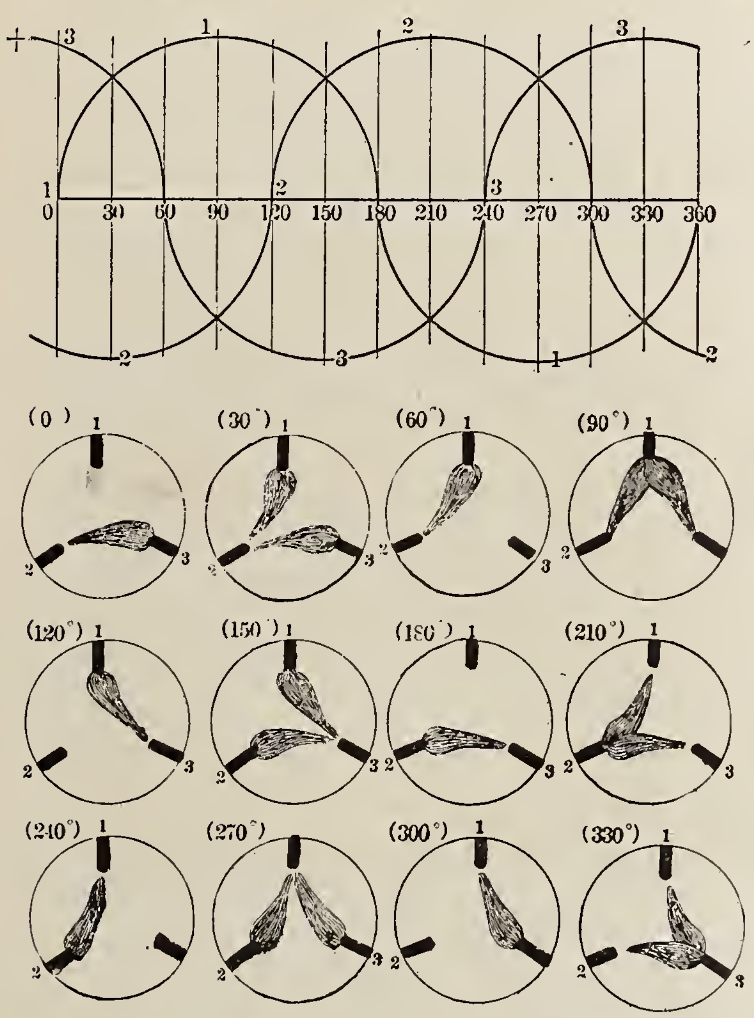
If we examine this arc light very carefully through dark glass, either smoked or colored, or better still, project an image of the arc on a white screen in a darkened room, using a good achromatic lens of large aperture and moderately long focus, we shall see pictured out a beautiful but inverted image of the arc in correct colors and intensities.

Knowing the direction of the current, we notice that the positive carbon has a very sharply defined crater of dazzling whiteness of about $\frac{1}{5}$ or $\frac{1}{4}$ the diameter of the carbon itself. From the crater the somewhat rounded point of the carbon diminishes in brightness, and finally verges into the dark unchanged carbon. Upon this heated carbon point the evidence of combustion is plainly seen in shape of changing surface and falling or accumulating ashes or secoriæ, while about it may be seen the flames of the burning carbon. The appearance of the negative carbon is quite different and clearly characteristic. The point is sharper, often with a little tip at the extreme end, while its base has a sort of crown or wall of ashes. The little tip is of whiteness equal to that of the crater of the positive, but very small indeed. Below this tip is the hot pointed carbon which, however, is not nearly as hot as the positive.

In the space between the two carbons is the bluish violet light of the incandescent vapor in the path of the current. This is the arc itself, relatively non-luminous and in volume conical. The base of this blue cone is as large as, and is in contact with the crater, while the apex just touches the white tip of the negative carbon. Surrounding this core are several layers of gases of various shades of blue and yellow, and the flames of the burning carbon. The light thrown out by this combination of causes may be considered as coming from four sources. By far, the greater part from the white hot surface of the crater on the positive carbon, a much lesser amount from the little white tip of the negative; less than this from the carbons considered simply as two red hot sticks, and a very small amount from the hot gases. It is evident that a large part of the total light will be thrown downward.

Upon stopping the current, the heated carbons glow for some time; the positive is, however, very much hotter than the negative and keeps hot longer.

If, after the carbons have become cool, an alternating current is caused to pass between them, and sufficient time allowed for the points to become settled into their normal shape, it will be seen that the arc is naturally different in appearance from the direct current arc. Both carbons will be of the same shape, having rounded points, each with a small luminous crater, from which is emitted the greater



part of the total light of the arc. Both carbons will show similar signs of combustion with the accompanying flames and ashes, and the light will be thrown upwards as well as downwards.

The blue arc between the two craters will appear as a band of nearly the same width in all parts, while about it are the several gaseous envelopes of different degrees of intensity. Upon shutting off the current, both carbons will be found of the same degree of luminosity and heat.

Somewhat more than a year ago I wished to demonstrate to the senior class in electrical engineering, during a lecture I gave them on alternating current phenomena, that, although when examined by means of a large projected image upon a white screen in a darkened room, the alternating current arc appeared to be as steady as the direct current arc, and the light was thrown equally upwards as well as downwards, yet there were very great fluctuations in the light due to the intermittent heating of the carbon points.

(*To be Continued.*)

Alton, N. H. —The construction of a telephone line connecting Alton and Wolfeborough is being agitated.

Is the Corona of the Sun an Electrical Phenomenon?

(*Continued from Page* 147)

The nature of these discharges was worked out by me several months before the publication of Nikola Tesla's and Professor J. J. Thomson's magnificent experiments. A considerable number of results which I obtained in my experiments are merely repetitions, on a small scale, of the results obtained by these scientists. There is, however, one line along which there seems to be but very few points of contact between their work and mine. This line runs in the direction of investigating the relation between the character of the discharge, the pressure in the vacuum, and the effective e. m. f. which produces the discharge. The following experiments will show some of the characteristic features of this relation:

ON THE CRITICAL POINTS OF THE DISCHARGE.

A vacuum jar, of the form and dimensions as given, was substituted for the small double bulb. The bulbs were totally immersed in large glass beakers, containing clear, distilled, acidulated water. The air pressure in the bulbs was a little less than 2 mm. Instead of a small alternator a large alternating current machine fed the primary. On closing the primary circuit the discharge between the bulbs started long before the resistance box, indicated that the e. m. f. in the secondary coil had reached its maximum. The crimson luminosity was very soft, steady, and distributed in accordance with the distribution of the potential which one would expect in an electrical system of the above description. Touching the narrow tube at any point increased the luminosity below the point touched, evidently due to the increase of the static capacity at that point. Diminishing gradually the e. m. f., the luminosity of the discharge diminished with it, and then stopped suddenly as if a critical point had been suddenly reached. Reducing the e. m. f. gradually to zero, and then gradually increasing it again, it was found that the discharge would cease at a point much lower than the point at which it would start again, the difference between the two points diminishing considerably with the rapidity with which these variations were made. The discharge will start at a much lower e. m. f. if solicited; that is to say, if the long tube is touched at one or more points. A wire bent in the shape of a Leyden jar discharger does very good service as a discharge "solicitor."

The discharge was similarly affected by varying the capacity. Performing the last experiment, but with the small vacuum jar already given, it was found that with a given low potential the discharge did not start until the bulbs had reached a certain depth, and then it started suddenly. Raising the bulbs gradually, and therefore diminishing the capacity, the discharge became fatnter and fainter. but it did not cease until the bulbs were entirely lifted out of the water. On immersing again, the discharge did not start until a certain depth was reached. The depth at which the discharge would start this time was smaller than in the first place, and the smaller the shorter the interval between the time of taking the bulbs out and immersing them again. This difference is of course due to the improved conductivity of the gas, and this again may in a certain measure be due to the rise in temperature of the gas on account of the heating effect of the discharge; but only in a small measure, for the bulbs were under water, so that the sides, heating the bulbs with a Bunsen burner before immersion did not diminish the depth at which the discharge would start nearly as much as a previous discharge would, no matter of how short a duration. As stated above, the discharge may be started far below the critical point by touching the connecting tube. But if the touch lasts only a very short time (a fraction of a second) the discharge ceases as soon as the touching conductor leaves the tube. In this manner the vacuum tube may be made to blaze up in quick succession. (*To be continued.*)

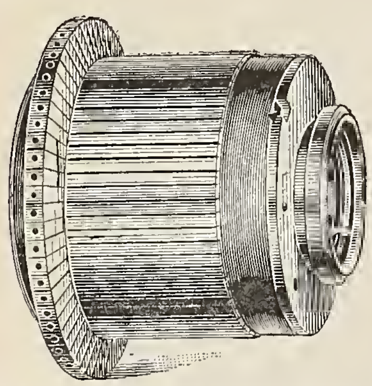
PRINCIPLES OF DYNAMO DESIGN.

BY

Newton Harrison E.E.

(*Continued from page* 138.)

In the general construction of commutators it is necessary to determine the angle and size of commutator segment. Mr. W. B. Cleveland has constructed a table as given of much practical benefit. "It enables the degree and angle chord to be determined for commutators of from 4 to 375 divisions of bars. The chords show the increase per inch in thickness of commutator bars of various angles, and are also the thicknesses of a division of a commutator of one-inch radius including the mica. To obtain the thickness of a bar from the drawing, it is merely necessary to multiply the chord corresponding to the number of divisions by the radius of the commutator, and then deduct the thickness of the mica to be used. For estimating the weight of the bars thus determined, it may be noted that copper is about 20 times the weight of a light soft wood pattern.



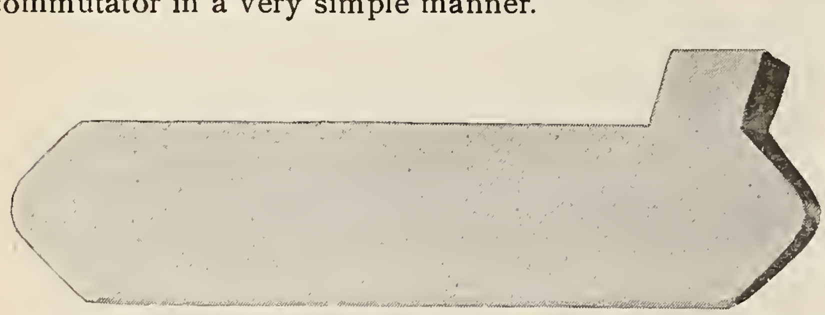
COMMUTATOR FOR RAILWAY MOTOR.

ARC COMMUTATOR.

In applying the last table to a practical case it is necessary to appreciate the meaning of the two columns. The first refers to the number of segments in the commutator; the second gives the number of degrees corresponding to each segment and the span or chord of that angle.

A commutator having a diameter of two inches and four segments would, according to the table, have an angle of 90 degrees to each segment and a chord length of 1.4142 inches.

The size of this chord can be found for any other sized commutator in a very simple manner.



SEGMENT FOR CAR MOTOR COMMUTATOR.

Multiply the angle chord by the radius of the commutator and chord is at once obtained in inches. To illustrate further:

Number of Divisions = 24
Diameter of Commutator = 6 inches.

To find angle and chord.

Following the column of divisions until 24 is reached the angle of 15 degrees is obtained and value .2611 as angle chord. The chord proper = .2611 × 3
= .7833 inches.

This corresponds to the chord of each segment of that commutator at the outer surface.

The thickness of mica for each segment should be subtracted to give exact size.

(*To be Continued.*)

ROENTGEN RAYS.

The Phenonenon of Light.—It is held that light is due to the undulations of the ether, just as sound is due to undulations propagated through the air. In the latter case the undulations cause the drum of the ear to vibrate and produce the sensation of sound. In the former case the undulations cause points of the retina to vibrate and produce the sensation of light.

Length of Light Waves.—Although the length of the undulations cannot be observed directly, yet they can be inferred from certain phenomena with great exactness. According to the lines on the spectrum the lengths are as follows:

Dark Line.	Length of Undulation in Inches.
B	0.0000271
C	0.0000258
D_1	0.0000232
E	0.0000107
E	0.0000191
G	0.0000169
H_1	0.0000159

The Sensation of Light.—It will be remarked that the limits are very narrow within which the lengths of the undulations of the ether must be comprised, if they are to be capable of producing the sensation of light. In this respect light is in marked contrast to sound. For the limits are very wide within which the lengths of the undulations of the air may be comprised when they produce the sensation of sound.

What is Color.—The undulatory theory readily explains the color of different bodies. According to that theory, certain bodies have the property of exciting undulations of different lengths and producing light of given colors.

White light or daylight results from the coexistence of undulations of all posible lengths.

The color of a body is due to the power it has of extinguishing certain vibrations and of reflecting others; and the body appears of a color produced by the coexistence of the reflected vibration. A body appears white when it reflects all different vibrations in the proportion in which they are present in the spectrum; it appears black when it reflects light in such small quantities as not to affect the eye.

The Color of Transparent Bodies.—The theory of light likewise explains the colors of transparent bodies. Thus a vibrating motion on reaching a body sets it in vibration. So also the vibrations of the luminiferous ether are communicated to the ether in a body, and setting it in motion, produce light of different colors. When this motion is transmitted through any body, it is said to be *transparent*, or *translucent*, according to the different degrees of strength with which this transmission is effected.

The Number of Waves per second can be calculated from their length. If the velocity of light be 186,000 miles a second, the number of waves are equal to the velocity divided by their length. Dividing 186,000 successively by the wave lengths of red and violet light, we obtain for the first

434,420,000,000,000

undulations per second, and for the violet 758,840,000,000,000 per second.

Non-Conducting Conductors.—For frequencies of a million per second and upwards, such as occur in jar discharges, and perhaps in lightning, the impedance of all reasonably conducting circuits is the same, and independent of conductivity and permeability, and hardly affected greatly by *enormous* changes in diameter.

Copper Conducts as well as Iron.—When a sudden discharge had to pass through a conductor, it was found that iron and copper acted equally well, and indeed iron sometimes exhibited a little superiority, as the thickness of the conductor and its ordinary conductivity mattered very little indeed.

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CONTENTS.

JOURNALS AND EDITORS.

The choice of a paper is the result of a popular feeling—either a leaning of the mind and sympathies in in that direction—or the hypnotic effect of the masses upon one's own powers of criticism. The life imbued into the paper by the editor's pen may be directed in a false channel and the ideas suggested with all their interest and excellence may be wasted, or if not wasted, ignored. Therefore it seems that, aside from the inward tendencies of an editor's mind, he must very frequently thrust aside his own inclinations and feel, if he can, *the pulse of the people.* In a trade journal such as we present to you there is much that impresses the reader with a variety of opinions—we strongly desire to hear them.

In this new departure we have striven to meet with the requirements of a trade journal—we are equally prepared to listen to advice, approbation or rabid criticism.

Let some of those whose interest in our welfare has not ceased take this opportunity and speak. Our columns, we think, are breathing with a new life and their inviting resources shall prove, we believe, a fund of useful and instructive information.

THE LIGHT OF ALTERNATING CURRENT ARC LAMPS.

The excellent paper presented by William L. Puffer shows that a patient and exhaustive series of experiments have been made for the purpose of studying the light of alternating current arc lamps.

The method he has employed and the happy facility with which he followed up each new suggestion are illustrative of a trained and scientific mind. The American Institute of Electrical Engineers has a competent member in the person of our esteemed contributor, and we believe that his future papers will not lack what this article possesses in truth and veracity.

THE GOLD FIELDS OF THE SOUTH.

The young engineer stands on the open threshold of the world and looks around with alarm.

All occupations are filled, thousands seem to be seeking for the standing he has intended to assume. Many in whom he recognizes superior qualities—in whom age and experience would scoff at competition with himself—are hurrying past him. A silent fear creeps into his heart as he thus views the masses he is about to meet. Perhaps he bends his neck at once to the yoke aad accepts the monotone of a quiet unprogressive and useless existence with resignation. But many a man filled with self-confidence turns his eyes away—he sees the crowd compressed into a narrow, struggling stream, and beyond in the wider, more open and healthier field he sees room and space.

The engineering industries of South America are about to bud into maturity. The progressive instinct of the people has been aroused and the ambitious engineer alive to such opportunities will find in these southern lands a sympathetic race, from whom he can earn, should his energy be unfailing, both wealth and fame.

ONE HUNDRED YEARS AGO.

"The philosophy of Plato began in words and ended in words," but "The philosophy of Bacon began in observations and ended in arts." A giant mind gave issue to these thoughts and their appeal to our inward sense proclaims their truth and consistency.

When suggestions ended deeds began—the awakening seed of fact began to sprout and thrust its tiny shoots through the dark soil of ignorance.

One hundred years ago inventions were few, clothes and household utensils costly, and almost all the common necessities of our daily lives unattainable luxuries.

A china plate, particularly in this country—while not an exceptional rarity—was not the popular article that it is today.

The old stage road stretching from New York to Albany was the scene of plodding haste, and its nestling towns of Irvington and Dobbs Ferry the stopping-places at which existed beneficent hostelries so grateful to the wearied traveller.

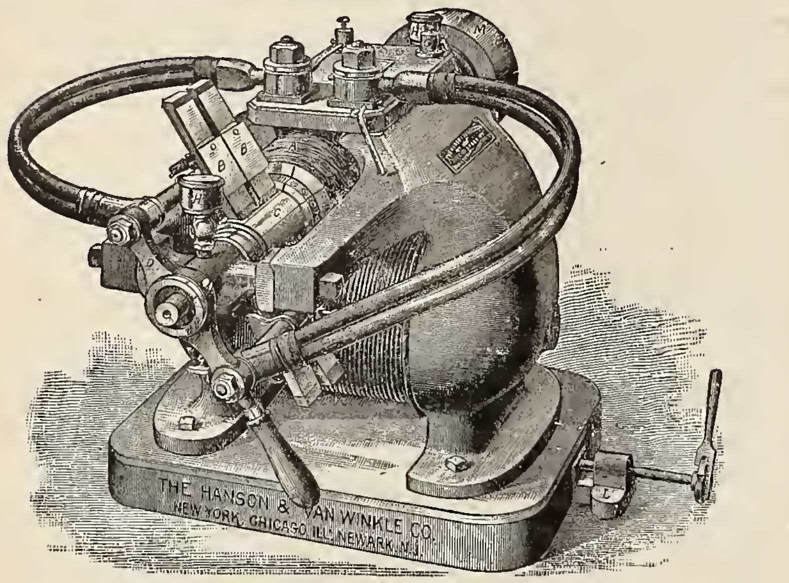
The active mind has changed these modes of travel—the steamboat now churns on its noisy way—the swiftly moving train shrieks as it rushes by and within the busy towns, the whirr of trolley cars and the gleam of bright lights shows us today that one hundred years have past.

Horse-Power of a Lightning Stroke. — At Klausthal, in Germany, according to *Machinery*, a lightning stroke struck the wooden post of a house, and fused two nails four millimeters thick. Messrs. Siemens & Halske, of Berlin, afterward carried on a series of experiments to ascertain the force required to melt this quantity of iron. Assuming one second as the time standard, it required a current of 200 amperes and 20,000 volts, representing 7,000 horse-power. Assuming that the lightning occupied one-tenth of a second to fuse the two nails, the horse-power required would be 70,000.—*Scientific American.*

ELECTRO-PLATING.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.



PLATING DYNAMO.

The stripping bath if used for a dip or two of the metal to be plated will remove all traces of oxide; in fact, it will act so successfully on a plated object that it will remove all the deposited metal in short order. The alkali bath of caustic soda attacks any and every form of grease, oil, etc., leaving the object clean and ready for a second cleansing in a vat of live water.

Metal, especially copper, can sometimes be deposited on a body due to the fact—the relation existing chemically will cause a coating of pure metal to form.

by noting the current in amperes for a given surface of copper and regulating it as the table indicates.

Proper current for deposit.

	Amperes per 100 sq. inches.
Copper cyanide bath.........	2 to 3
Tough deposit..............	1 5 " 4
Very tough.................	4 " 10
Very solid.................	10 " 25
Solid, but sandy at edges.....	50 " 100

For weak solution and a strong current a black deposit ensues, and gas is liberated at the cathode pole.

For a strong solution and a weak current the deposit is crystalline and useless.

It is sometimes considered good practice to connect a number of vats together in series; in such a case the volts required for the total number of baths on the basis given must be applied. For ten baths of three volts each 30 volts pressure is necessary. Plating can be done with a solution and a carbon anode.

If such were the case, however, the anode being unable to waste, the liquid would suffer, becoming greatly weakened, and unless strengthened by the addition of more salts ultimately losing all its metal, whether copper, nickel, silver or gold.

It is the practice to refine copper by using large vats in series with each other, as described. A dynamo of the requisite pressure sends the current through the series.

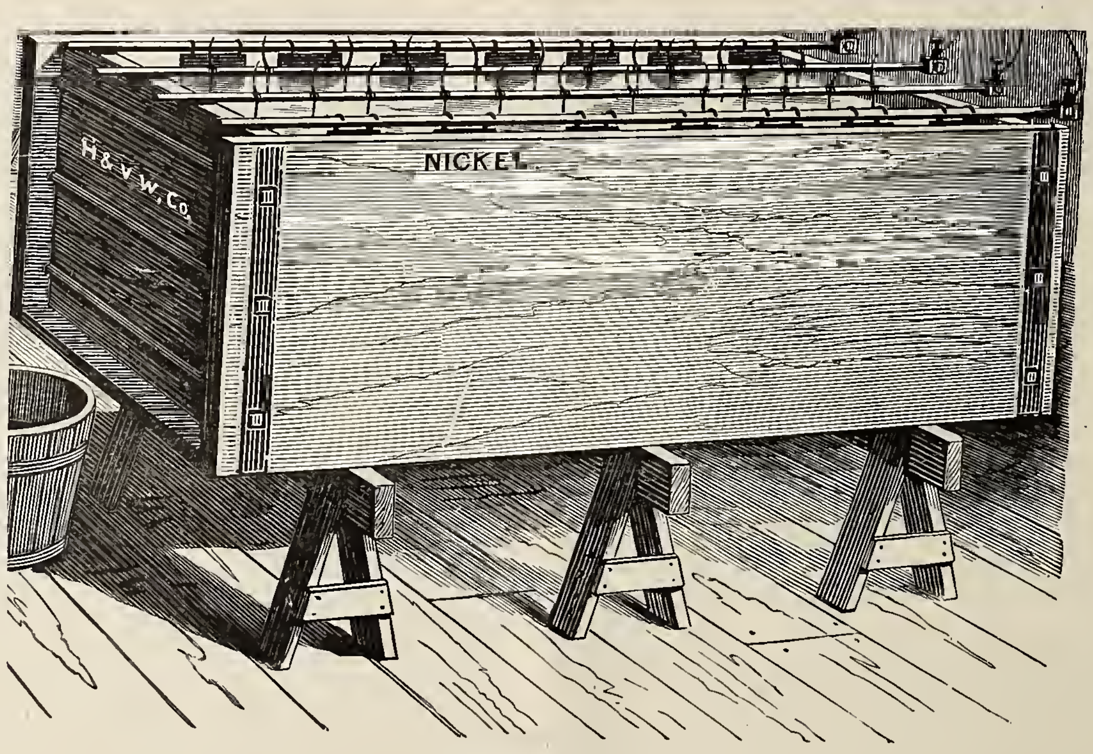
Huge blocks of the crude ore are connected to the positive pole and used as anodes.

The cathode is a thin plate of copper. Only pure copper is deposited upon it, and this is allowed to thicken until it is in the shape of thick plates or large ingots.

They are taken and rolled into wire or used for miscellaneous purposes, being about 96 to 98 per cent. pure copper.

The sediment or sludge is retained and the metal it holds, either in the shape of salts or particles, is recovered.

About three dollars' worth of gold and silver is obtained



NICKEL BATH.

Bright steel dipped into a copper solution receives a red coat of copper, the metal being precipitated without the aid of any current.

A weak current will deposit upon the cathode or negative pole a deposit that is inclined to be brittle and crystalline in nature.

A strong current will cause a deposit that appears to be composed of disintegrated particles of copper. They are black and powdery and of no use at all, though consisting of pure copper.

The proper current will give a characteristic deposit of tough and close-grained copper.

The determination of the proper current can be obtained

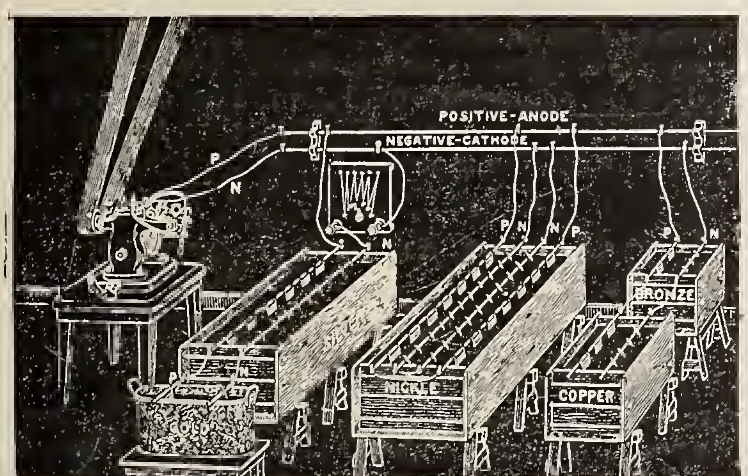
from each tank after a few days' run. The richness of the copper ore in these valuable impurities greatly varies, being from a dollar to three or even more per ton if the ore is rich.

Quicking a piece of metal is the process of covering its surface with mercury before plating. A solution made by dropping mercury into nitric acid will be useful for this purpose, if applied to the surface of the object.

When the article has received a coating of sufficient thickness it is removed from the bath and dried in sawdust, after being washed. It is then *buffed*, or, if the surface is rough, exposed to the action of a circular brush having wire instead of hair or bristles as its effective portion.

Scratching is the name applied to such work, and between the two the object becomes perfectly smooth and endowed with a bright lustre. To perfect the work further and produce a surface of excellent quality, the process of *burnishing* is carried on.

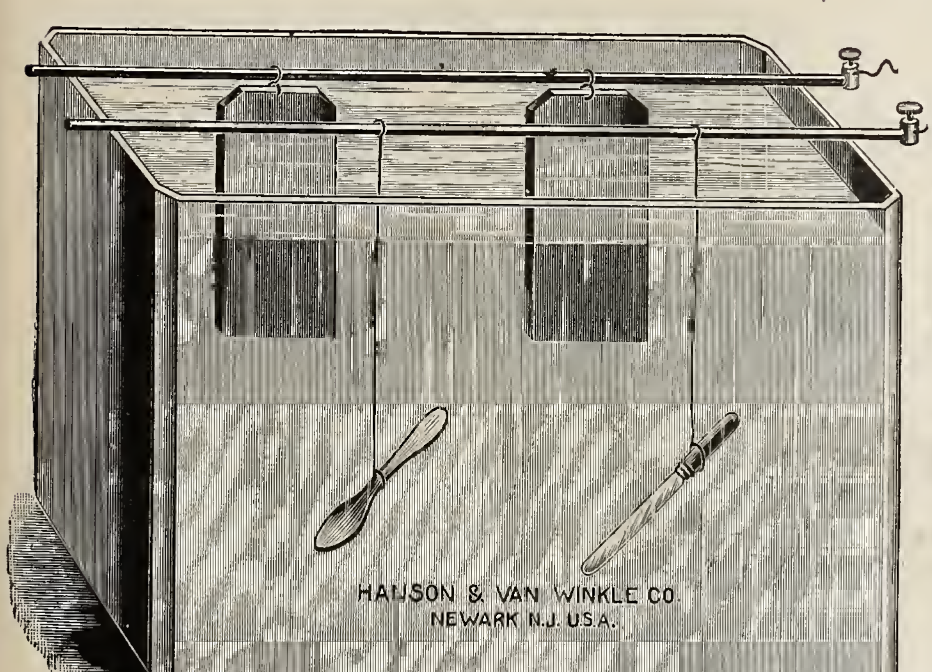
This is done by means of a smooth curved surface applied to the deposit very briskly and with considerable pressure. An object that has been covered with a coating of metal under which exists a surface of oxide is likely to *peel*. The way to eradicate this trouble is to treat the surface beforehand to a dilute solution of acid, or give it a rapid dip in the stripping bath.



METHOD OF CONNECTING UP.

Certain classes of solutions do not conduct electricity very well, such as tetra-chloride of zinc for instance; nitrates in solution are very difficult to handle because of their rapid oxydizing power. The deposit of metal can only be obtained by the greatest care. The free acid released by electrolysis is the direct cause of the trouble. *The best solutions* are made up of sulphates or cyanides of the metal

An excellent formula for a copper sulphate solution is as follows:



METHOD OF SUSPENSION.

Acid copper solution.—Prepare a saturated solution of copper sulphate, warm water will be very effective in this respect for the rapid preparation of an intense solution.

Take 1 gallon of saturated solution.
1 quart of water.
1 ounce sulphuric acid.

The preparation of an alkaline solution for deposition upon iron and zinc is covered by the following:

Alkaline solution of copper.—Mix a solution of copper sulphate and cyanide of potassium together. A precipitate falls to the bottom of copper cyanide. The precipitate is washed in pure water and strained, then redissolved in a solution of cyanide of potassium and water.

A cyanide of potassium solution is made by dissolving two pounds of cyanide to one gallon of water.

After the copper solution has been obtained by the above method two ounces of cyanide is added to each gallon of copper solution.

This solution works heat at 100° F., but a heavy current will cause a good deposit at 30° F.

In nickel plating certain precautionary measures are adopted to insure good results. A very strong solution will be as injurious to the deposit as a heavy current. The solution and current therefore determine the quality of the deposit, while it is known that about 30 to 40 grains per hour of copper express the limit for good plating; the conditions of nickel-plating forbid a similar statement.

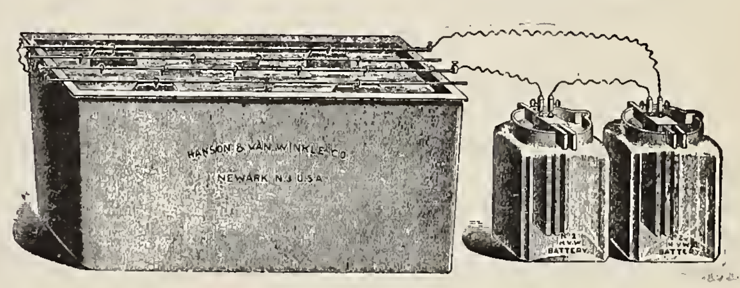
Nickel is best deposited from a salt composed of two in active conjunction—salts of nickel and ammonium. The processes of preparation are two-fold; when separately obtained they are mixed as described.

(I)

Sulphate of nickel

3 parts nitric acid.
1 part sulphuric acid.
4 parts water.

Dissolve in this solution two pounds of nickel to each gallon and gradually heat until the nickel is entirely dissolved. When this occurs add one-quarter of its volume of hot water and filter.



PLATING WITH PRIMARY BATTERIES.

(II.)

Ammonia solution.—Dissolve sulphate of ammonia in hot water until the solution is saturated; about four pounds to the gallon will be sufficient.

The two solutions of nickel and ammonia are mixed in equal quantities.

The precipitate that falls when both are mixed is then washed in a portion of the ammonia solution.

This sediment is the plating salt, the double salt of nickel and ammonia.

For use mix three-quarters of a pound of this salt to one gallon of water. The solution must be chemically neutral. This is accomplished by testing with litmus paper.

The paper is simply dipped in.

If the litmus paper becomes red add sulph. ammonia.
" " " " blue " " nickel.

A SURGEON'S SECOND SIGHT.

The utility of X rays is being practically demonstrated almost every day.

The latest we have to present is contained in the following extract:

(Special to *The World.*)

New Haven, March 26.—An employé at the Winchester Repeating Arms Company was injured by an explosion, his hand being badly perforated by the primer mixture. The hand was today photographed with X rays by Prof. C. S. Hastings, of Yale, and the location of twenty-three pieces of mixture was determined.

All were removed.

The Hoe Building at 28th street and Fifth avenue will be equipped with 2,000 lamps for street circuit. Habishaw wire, iron armored conduit and electric elevators will complete the equipment.

Interesting Facts in Science.

Argon—The Mysterious New Element.—A peculiar difference existing between the nitrogen of the air and that liberated from chemical compounds has led to frequent discussions as to its real nature. Argon, a mysterious new element, has been discovered in close association with nitrogen. This new element of the air has been separated from it by first absorbing the oxygen, then passing the residue of gas over white hot magnesium filings. Argon is left after the nitrogen has fully combined with the magnesium.

It represents about four per cent. in volume of the nitrogen. It has been solidified into white crystals that melt at 309.28° F. Its most remarkable property seems to be its incapability of combining with anything. Meteorites have been found containing it. What its real nature is has yet to be discovered.

The Star Algol.—One of the great fixed stars is Algol. Its diameter is enormous, being 1,000,000 miles. It has a companion in its journey through space whose size is also very great—about 800,000 miles in diameter. They both forge forward with a high degree of speed. Algol having a velocity of 25 miles a second. They are 3,200,000 miles apart from center to center. The sun itself has not much more than twice the mass of Algol. These mighty creations have remained for ages seemingly in the same spot. They are part of the great systems spanning the heavens.

Aluminum Torpedo Boats.—The great lightness of this metal has led to its introduction in naval service. Its strength is greatly increased by a small percentage of copper. Boating crews have used aluminum outriggers with success. An exploring expedition into Central Africa, headed by Montreuil, took with them a flat bottomed ferry boat made of aluminum. The firm of Yarrow & Co., of England, delivered a torpedo boat on order to the French Government; it was alloyed with six per cent. of copper. The cost was about twice that of steel. The increased facilities in manufacture will bring it within the compass of the more economical minded and greatly popularize its use, not only for naval and marine, but for building purposes.

Impenetrable Clothing.—Bullet-proof clothing has of late come before the public eye. Hiram Maxim, the great gunmaker, invented a breast-plate made of thin steel and felt. Bullets that pierced a steel target half an inch thick were successfully resisted by it. Lennard made a bullet-proof shield of a mixture of felt and wool. Rifles of the Springfield and Winchester manufacture were used to fire the bullets. None penetrated through, although many were imbedded. A steel shield of the same size would weigh at least 25 pounds. Lennard's, however, weighed only 11 pounds. A man in Passaic named Lucas built an impenetrable coat; a German army rifle was used upon it but no bullet passed through. Should such articles be used in warfare a man would be as healthy an antagonist to meet as an alligator or rhinoceros.

Air Ships for Ocean Transit.—The future generation will probably be blessed by a near acquaintance with the new means of aerial navigation slowly being evolved. The harrowing details of balloon escapes, the wonderful journeys across the continent in the face of a howling hurricane, or the thrilling episodes connected with a trip across the ocean's bosom far up above the clouds have become only too familiar to the general public. The aeronaut must be a man of iron nerve. The maddening sense of utter loneliness, of complete isolation has tried the energy of many a mid-air traveller. This time is slowly passing. A fund of facts have been obtained by men of science. The balloon has become a worn out bag of gaseous nonsense. To move through the air on a solid support controlled by powerful machinery is at present the problem engineers are trying to solve. Congress was once asked to appropriate funds for an experiment, the object of which was the employment of exhausted vessels of steel to rise under such conditions by their own specific gravity. Such shells would be as frail as soap-bubbles and as useless for such purposes. The greatest attempt ever made to solve this problem occurred under the directions of Hiram Maxium.

A machine weighing 8,000 pounds was lifted from the ground so forcibly as to tear away the restraining rails and wreck the apparatus. An aëroplane or helix revolved in the air exerting this enormous lifting power. A steam engine of very light construction was used to drive it. Its power was sufficient to lift itself, engineer and accessories. The demonstration of its direct applicability as an aeronautic vessel was clearly evident. This advance from all past experiments gave a new tone to the work. The use of an inclined plane swiftly revolving through the air as the lifting mechanism has been resolved upon by the Smithsonian Institution.

Recent experiments have confirmed this fact. To build a vessel for ocean transit would require the skill and efforts of the greatest engineers. The wings of Icarus were of wax; let ours be of tempered steel.

CAN OUR AUNTS DO THIS?

Sir John Lubbock describes an ant which can support a weight three thousand times heavier than itself, or equal in proportion to a man holding 210 tons by his teeth.

There are many *men* that hold more than 210 tons, not at once, but gradually, in modest portions. Falstaff was very ambitious in this respect and our worthy friend of the same calibre named Sir Toby.

Whether their teeth were employed in the manner described or not it is a difficult matter to say, but we can all rest content with the conviction that they held tuns (if not with their teeth, at least, their mouths); if not by the exercise of their biceps, with an equally interesting portion of their anatomy.

BARON ROENTGEN.

It is noticeable that the true noblemen are slowly coming to the front. Men with giant minds, gifted with natural abilities, with a strength of character, or power of thought that raises them above their fellow-men are always only too well known. The lambent light of genius destroys the shadows of our worldly experience.

A title of nobility attachedtothe name of a man of Roentgen's calibre adds but little to its lustre. Lord Kelvin has worn his newest coronet with well-earned grace. 'Tis a sign of moral advancement when a title is given to such—they are the men the king deligheth to honor. We salute thee: Baron Roentgen.

W. R. Ostrander & Co., manufacturers of speaking tubes, alarm whistles, electric bells, annunciators, electric light goods, etc., 204 Fulton street, New York, will move their New York salesrooms to 22 Dey street, in the heart of the electrical trade. The main floor will be used as retail salesrooms, while the remaining floors will be set apart for stock, etc.

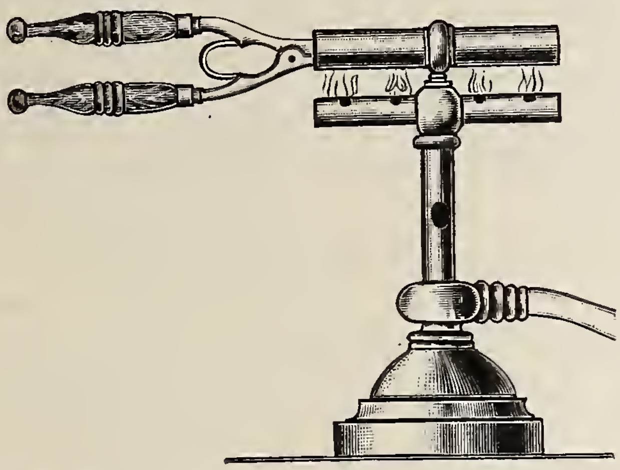
Rossiter, McGovern & Co., 141 Liberty street, New York, will move to 107 Liberty street, May 1. They have in stock railway generators, car equipments of Thomson-Houston and Westinghouse make; alternating and direct current machines, arc apparatus, motors, transformers, etc., all of standard manufacture.

Hatzel & Buhler closed a contract for the new Havemeyer Building, located on Broadway, between Prince and Crosby streets. The specifications call for 9,000 lamps; five 100-K.W. and four 50-K.W. generators of the General Electric Company; seven Armington & Sims engines, bought of E. P. Hampson, New York agents. The wiring to be done in iron armored conduit. All the telephones connecting to the offices to be run on the exchange system. And a messenger-call system will be installed. This plant will be the largest in the city.

IT WILL MAKE YOUR HAIR CURL.

To read this article is to be introduced to a new and convenient heater made by a well-known gas and electric fixture company.

The W. C. Vosburgh Mfg. Co., Limited, manufacturers of gas and electric fixtures, Brooklyn, N. Y., and Chicago,



Ill., have applied for letters-patent on a curling-iron heater and are now ready to supply the trade with same.

We give below a cut of this article, to which the name "Ladies' Delight" is applied. The device is made of brass, nickel plated and finished in first-class manner. The heat produced is atmospheric, causing no smoke nor odor, and does not discolor the curling-iron nor the heater itself. The iron is ready for use almost as soon as the heat is applied. Used with an independent connection behind a bracket it is the most convenient and practical curling-iron heater in the market. It will be seen from the cut that the supply of gas may readily be taken from an ordinary gas burner through a rubber tube.

Write them for further description and price.

PERSONAL.

Mr. Edwin S. Reid, who has been with the Standard Underground Cable Company for many years as superintendent of construction, has severed his connection with that company and has accepted a position with the National Underground Cable Company, with main office at New York and branch offices at Chicago, Philadelphia and Boston, as its general superintendent of construction, and all construction work done by the National Company will be under his immediate charge and supervision.

Mr. Reid, who was for many years associated with Mr. Steven D. Field in his various electrical works, entered the underground cable business in its earliest days, and many of the appliances used on underground cable work which have tended to make underground cables successful are of his invention and design.

The well-known Reid cable terminal which was invented by him only a few years ago has given such satisfaction and met the requirements of the users so well, that over 100,000 of them are in use today in the United States and Canada on telephones, telegraph and electric light cables for underground and aerial service.

There are but few underground systems in the United States which Mr. Reid has not had something to do with, and his experience covers not only the construction of cables but also the building of complete subway systems; and, besides, he has the advantage of being able to make the most delicate and complicated electrical tests, and of being master of electrical subjects generally.

Mr. Reid has already started in on his work with the National Underground Cable Company, and in the hands of one so competent the most satisfactory results are certain to be obtained.

The National Company is certainly surrounding itself with the most competent men obtainable, and is to be congratulated upon its enterprise and progressiveness.

INQUIRY COLUMN.

In this column we shall endeavor to answer all questions relating to the science of electricity that may arise in the minds of our subscribers.

ALBANY, N. Y.

ELECTRICAL AGE PUBLISHING CO.

Dear Editor:—I hear so much about the ampere I would like to know, as an interested reader, whether it is the real unit of current or not?

J. S. STRATFORD.

Ans.—The ampere is not the real unit of current; it is the practical unit. The absolute unit is equal to ten amperes.

ONTARIO, CANADA.

TO THE ELECTRICAL AGE.

Dear Sirs:—If a dynamo heats very greatly at the fields what is it due to? The lights burn dim also. I take advantage of your valuable columns to seek this information.

Yours truly,

F. MANNING.

Ans.—When the fields are overheated it is due to excess of current. If the trouble has recently developed, the speed being normal, one of the coils may be burnt out. You had better place your hand on each again and try to discover a noticeable difference. Let us know of your success.

WASHINGTON, D. C.

EDITOR OF ELECTRICAL AGE.

Dear Sir:—In wiring for 100 lights a distance of 175 ft. what size of wire would be used, the dynamo having a pressure of 110 volts; and if not asking too much, how is it done?

A CONSTANT READER.

Ans.—In wiring for a number of lights a given distance, a certain percentage of drop is always settled upon.

If it is assumed to be 2 per cent., in this case the size of wire required is No. 1 B. & S. on the basis of 50 amperes in the line; half ampere per lamp.

Current for 100 lamps = 50 amps.
Length of line 350 ft. = $2 \times 175'$
Drop is 2 per cent. = 2.2 volts.
Size of wire?

$$\text{Rule—circular mils} = \frac{\text{current} \times \text{length line} \times 10.8}{\text{volts drop.}}$$

$$\text{“} \quad = \frac{50 \times 350 \times 1\theta.8}{2.2}$$

$$\text{“} \quad = 85{,}909.$$

The nearest size to this is No. 1 B. & S.

(The number 10.8 is a constant used in all similar calculations.)

SAN FRANCISCO, CAL.

ELECTRICAL AGE.

Gentlemen:—As an outsider interested in electricity I have had frequent opportunity to notice the lack of light issuing from the globes of lamps used in my factory. Wanting to use my power to the best advantage, what globe is best in light-giving qualities? Thanking you in advance for your kindness, I am

Yours truly,

J. COPELAND SMITH, President.

Ans.—This matter relating to the light absorbed by different globes we place before you as follows:

Clear glass	absorbs	about	10 per cent.
Ground	"	"	30 to 50 per cent.
Opal	"	"	50 to 60 "

Hoping this may assist you we await your further pleasure.

12,000-VOLTS PRESSURE.

OFTEN lightning plays dangerous games with an electric light plant.

The investigation that follows usually brings to light an array of possible causes; yet the most prominent of them all might be traced to *defective insulation* and an imperfect system of lightning arresters.

To choose a good insulating material, that will meet with the approval of nature as well as the public, requires the very best judgment and experience. As an insulator it must stand unscathed the innumerable trials of daily practice, and it must vie in cheapness with the other products of the market. It must, in fact, compete in price and quality with the very best made. Paper insulation has been deemed by many the most satisfactory material to use in such a case, and the excellent cables made by the National Underground Cable Company are protected by this very material. To show its excellence the cable was able to withstand a pressure of 12,000 volts, alternating current, and over 7,000 volts in subway. The test makes it superior to its guarantee. The above sketch shows a sample piece of this remarkable cable $\frac{5}{32}$ paper insulation.

EDISON'S GENIUS.

THE TUNGSTATE OF CALCIUM FLUOROSCOPE.

March 28, 1896.

Editor of Electrical Age.

Sir:—Messrs. Aylsworth and Jackson, of East Orange, N. J., presented me on behalf of Mr. Thomas Alva Edison with a tungstate of calcium fluoroscope. It is a magnificent piece of apparatus and will undoubtedly prove of the greatest service in the new field of work opened up by Roentgen's discovery. I cannot speak too highly of its merits, and I take much pleasure in recommending it to all who are interested in Roentgen radiance. I wish to state also that this recommendation is spontaneous and not in any way suggested or even hinted at by the generous donors.

Mr. Edison and his assistants, Messrs. Aylsworth and Jackson, deserve the deepest gratitude on the part of scientific men and the public at large for their magnificent fluorescent screens.

Yours, etc.,
M. I. Pupin.

TELEPHONING FROM CONTINENT TO CONTINENT.

Extract from Journal.

Clark D. Vaughn, the young manager of the Western Union Telegraph Company's station at West Fifth street and North River, has made application for a patent upon an invention which it is said promises to revolutionize telephoning. In a few days he will ask for permission to experiment over the cable company's lines, and is confident that speaking communication can be established between New York and London.

Thos. A. Edison, when asked about Mr. Vaughn's new transatlantic telephone, said:

"There is nothing in it. It cannot be done. It is impossible to get more than six waves of sound a second through the water at that distance. When any more than that are put through it runs together at the other end and is unintelligible. A telephone cable from New York to Coney Island is impracticable. I have had experience with it, and have learned through my own failures. If Mr. Vaughn can do what he claims, it is worth $250,000 But he cannot."

PRELIMINARY STATEMENT.

FROM U. S. GEOLOGICAL SURVEY DIVISION OF MINING STATISTICS OF THE PRODUCTION OF LEAD FOR THE YEAR 1895.

Returns from all the refining works show that the total production of Desilverized Lead was 201,992 net tons in 1895, as compared with 181,404 net tons in 1894. The desilverized lead included 6,244 tons of Hard Lead. Desilverizers reported that 51,613 tons of their product were obtained by refining foreign base bullion in bond. Of this quantity 17,282 tons were exported.

The production of soft lead in Missouri and Kansas in 1895 was 39,890 tons.

NINETY IN THE SHADE.

In summer the sun is further away from us than in the winter; yet its heat is so intense at times as to make us doubt this solemn fact. Perspiring business men, restaurant keepers and hospitals find in the electric fan a relief that is indescribable.

A cool refreshing breeze during the dog-days means health and activity. There are none that should forget this fact—or the fan that brings such comfort.

The Interior Conduit and Insulation Company have issued a handsome and complete catalogue showing their

LUNDALL LOW CEILING FAN.

line of Lundell fan motors for the season of 1896. These machines—some 20,000 of which are now in actual use—are so well known throughout the country that a description of them is entirely superfluous. Special mention, however, should be made of several new styles which are now offered for the first time. The Lundell "White Wings," illustrated, is a decided novelty. This is a ceiling fan motor with aluminum blades made in two sizes and especially adaptable for low studded ceilings. The outfits are complete and most efficient, of handsome design, and are the lowest priced ceiling fan motors on the market. New designs in suspended and bracket fan motors are also shown in the catalogue. This large and varied line of Lundell fan motors will meet with the commendation and recognition of the trade at large.

UNDERGROUND CABLES.

The National Underground Cable Company has just received an order from the West End Street-Railway Company, of Boston, covering all the lead-covered underground feeder cable to be used by the latter company during the year 1896.

The first work to be done on this contract will be for about twenty-one miles of 500,000 circular mils cable and two miles of 1,000,000 circular mils cable. The West End Company has been using for sometime large quantities of the National Company's cable, and the giving of this order speaks for itself as to the quality of the cable and the satisfaction it has given.

This contract of the National Underground Cable Company covers also the laying and connecting of the cables in Boston and the doing of all the work.

INVENTORS AND INVENTIONS

OF THE GREAT ELECTRICAL EXHIBITION.

FOR many days the manufacturers have talked about the opening of the great electrical exhibition at the Industrial Building, New York. The time is slowly approaching and applications for space are piling in. Clarence E. Stump, the manager, believes that every manufacturer of electrical goods will participate and try to make it one of the greatest successes of its kind. The benefit the manufacturer and public receive from such an exhibit is almost incalculable, while the trade sells to the trade it is the consumer that ultimately buys—the visitor at these exhibits, the mere outsider. Let him judge of the tremendous progress made since his last glimpse of the marvels of this century.

It is to be expected that an electrical exhibit will impress the reflective mind as would a map or topographical view of a country. Its characteristics, peculiarities of formation, are all placed before the eye. An exhibit of this kind will do likewise. It will show new and startling discoveries, the latest fruits of the inventive mind, the matured specimens of an applied science.

The fascination of fact will be greater than the delusions of fancy. Strange developments have taken place within a short space of time; we stand today on the verge of new discoveries.

The successive steps of progress for the last one hundred years, with all its short-comings and deficiencies, will be noted at a glance. Who has ever seen a complete historical exhibit covering all from Franklin's time to the present day.

What pessimistic reviler of the use and growth of industrial arts can help being impressed with the sight of these primitive specimens, these veritable germs of growth in comparison with the elegant and perfected appliances of the General Electric and Westinghouse Companies. Such a comparison will strike the mind with wonder and pathos.

An exhibition covering the latest developments in science even to the use of the X rays is not to be missed by any live man.

A course of lectures will probably be delivered by leading scientists; and institutes and schools will have ample opportunity to derive every benefit from so useful and instructive an exhibition.

LIST OF EXHIBITORS.

Abendroth & Root Co., New York.
Adams-Bagnall Electric Co , Cleveland, O.
American Carbon Co., Noblesville, Ind.
American Stoker Co., Dayton, O.
Babcock & Wilcox Co., New York.
Ball & Wood Co., New York.
Bishop Gutta-Percha Co., New York.
Birdsall Electric Mfg. Co., New York City.
Bryant Electric Co., Bridgeport, Conn.
Brady, T. H., New Britain, Conn.
Bradford Belting Co., Cincinnati, O.
Bryan-Marsh Electric Co., New York.
Bossert, Wm. F., New York.
Barry, John, New York.
Carpenter Enamel Rheostat Co., Hoboken, N. J.
Calculagraph Co., New York.
Clark Electric Co., New York.
Columbia Incandescent Lamp Co., St. Louis, Mo.
Corey, R. B., New York.
Chapin-Douglass Electric Co., New York.
Cutter Electrical Mfg. Co., Philadelphia, Pa.
Crocker-Wheeler Electric Co., New York.
Columbia Rubber Works Co., New York.
Crouse-Tremaine Carbon Co., Fostoria, O.
Crane Co., New York.
Diehl Mfg. Co., Elizabethport, N. Y.
Dale, Farrell & Co., New York.
Eddy Electric Mfg. Co., Windsor, Conn.
Edison Electric Illuminating Co., New York.
Electrical Engineer, New York.
Electricity Newspaper Co., New York.
Forest City Electric Co., Cleveland, O.
Ferracute Machine Co., Bridgeton, N. J.
Fuel Economizer Co., Matteawan, N. Y.
Goubert Mfg. Co., The, New York.
General Electric Co., Schenectady, N. Y.
Gordon-Burnham Battery Co., New York.
General Incandescent Arc Lamp Co., New York.
Harrisburg Foundry Machine Co., Harrisburg, Pa.
Huebel & Manger, Brooklyn, N. Y.
Holtzer-Cabot Electric Co., Boston, Mass.
Heine Safety Boiler Co., St. Louis, Mo.
Hunt, C. W. Co., New York.
Iron-Clad Rheostat Co., Westfield, N. J.
India Rubber and Gutta-Percha Insulating Co., Yonkers, N Y.
Jewell Belting Co., Hartford, Conn.
Johnston, The W. J., Co., New York.
Keasbey, R. A., New York.
Kennedy Valve Co., New York.
Keuffel & Esser Co., New York.
Losier, R. T., New York.
Locke Regulator Co., New York.
Mica Insulator Co., New York.
McEwen, J. J., Mfg. Co., Ridgeway, Pa.
Niles Tool Works Co., Hamilton, O.
National Carbon Co., Cleveland, O.
National Conduit Mfg. Co., New York.
Nowotney Electric Co., Cincinnati, O.
Nuttall, R. D., Co., Allegheny, Pa.
Okonite Co., New York.
Phœnix Iron Works, Meadville, Pa.
Peck Electrical Co., New York.
Partrick & Carter Co., Philadelphia, Pa.
Peru Electric Mfg. Co., Peru, Ind.
Payne, B. W. & Sons, Elmira, N. Y.
Reisinger, Hugo, New York.
Riker Electric Motor Co., Brooklyn, N. Y.
Roebling's Sons, John A., Co., New York.
Stirling Co., The, Chicago, Ill.
Schieren, Chas. A. & Co., New York.
Siemens & Halske Electric Co. of America, Chicago, Ill.
Sunbeam Incandescent Lamp Co., Chicago, Ill.
Straight Line Engine Co., Syracuse, N. Y.
Standard Electrical Lamp & Novelty Co., New York.
Standard Paint Co., New York.
Standard Underground Cable Co., Pittsburgh, Pa.
Shultz Belting Co.. St. Louis, Mo.
Stanley Electrical Mfg. Co., Pittsfield, Mass.
Safely Insulated Wire & Cable Co., New York.
Stanley & Patterson, New York.
Schoonmaker, A. C., New York.
Smeltzer & Co., Nurnberg, Bavaria.
Tucker Electrical Construction Co., New York.
United Electric Improvement Co , Philadelphia, Pa.
United States Mineral Wool Co., New York.
Vacuum Oil Co , New York.
Vetter, J. C., & Co., New York.
Walker Mfg. Co., Cleveland, O.
Warren, A. K., & Co., New York.
Wagner Electrical Mfg. Co., St. Louis, Mo.
Weston Engine Co., Painted Post, N. Y.
Weston Electrical Instrument Co., Newark, N. J.
Williamsport Wooden Pipe Co., Williamsport, Pa.
Worthington, Henry R., New York.
Wilkinson Mfg. Co., Bridgeport, Pa.

Gentlemen:—We shall be glad to have your estimate on "Electric Wiring" for 183d street station of New York and Harlem Railroad, for which we have the contract.

Yours very truly,
Jas. R. F. Kelly & Co.

New Corporations.

South Orange, N. J.—The South Orange Electric Light and Power Co. Capital, $50,000. Incorporators, Henry A. Page, Edward D. Page, W. M. Haines and Frank Brewer.

Cicero, Ind —The Cicero Heat, Light and Power Co. has been incorporated with a capital stock of $50,000. Directors, E. M. Henshaw, O. D. Hazlett and L. I. Treller.

Geneva, Ill —The Suburban Electric Railway Co. filed a certificate of incorporation. It was incorporated May 8, 1895, by G. I. Talbot, of De Kalb; C. L. McMurray, H. H. Galvin, of Chicago, and others, with $250,000 capital, to connect cities in Cook, Lake, Du Page and Kane counties.

Trenton, N. J.—Papers for incorporation for a new electric railway were filed in Trenton. The line will extend from Belmar to Spring Lake and Manasquan. The capital stock is $50.000. President, A. B. Wilbur, Jr.; vice-president, Geo. W. Varranhan; secretary, William B. Price of Newark.

Oregon, Mo.—Oregon & Forest City Electric Railway Co., of Holt County. Capital stock, $60,000. Incorporators, James E. Cummins, F. C. Oakley, Robert C. Benton, Shannon C. Douglas and James B. Harden.

Possible Contracts.

Eufaula, Ala.—Sealed proposals will be received, April 23, for erecting and installing complete an electric light plant. The proposed plant embraces sixty-six 1,200-candle-power arc and one thousand 16-candle-power incandescent lamps. Plans and specifications will be on file and may be seen at the office of the city clerk, and copies of specifications, forms, etc., may be obtained from the city clerk after March 20. G. A. Roberts, city clerk; J. L. Ludlow, engineer, Winston, N. C.

Haverhill, Mass. — The Haverhill, Georgetown and Danvers Street Railway has increased its capital stock to $60,000, and voted to build the road to Georgetown in the spring.

Greenwich, Conn.—The incorporators of the Port Chester and Glenville Tramway Co., recently organized, is about to make application to the selectmen of Greenwich for approval of the layout of a proposed freight trolley line from Port Chester to Glenville. The road is intended to carry freight between the mills at Glenville and the freight station of the Consolidated Road at Port Chester.

New York City.—Bloomingdale Bros. are to erect a ten-story store, loft and office building, to cost $125,000, at 78 Fifth avenue.

Charles S. Sentell will build a seven-story brick and stone store and loft building, to cost $30,000, at 341 West Broadway.

Bath, Me.—A new lightship now being built at Bath, Me., is to be placed in Boston Harbor. It will cost about $50,000, and $5,000 annually will be required to run the boat Electricity will be used for lighting.

Dayton, O.—The electric line of the Dayton Traction Street Railway Co. is to be continued to Cincinnati, a distance of 60 miles, within a year.

New York City.—Amund Johnson, 1635 Fox street, will erect an eleven-story brick store and lofts at 736 Broadway, at a cost of $165,000.

Akron, O.—There is talk of the extension of the Akron and Cuyahoga Falls Rapid Transit Co. to Cleveland. A meeting will be held in Akron, and the proposition to increase the capital stock from $600,000 to $1,000,000 will be considered.

Brooklyn, N. Y.—The Nassau Electric Railroad Co. has secured permits to build extensions in Church lane, 86th street, 5th avenue, 14th avenue and Bath avenue.

East Liverpool, O.—At the meeting of the city council of East Liverpool, the special committee reported in favor of the erection of a city lighting plant to cost $45,000. The question of issuing bonds in that amount will be submitted to the voters. The city is now paying $7,000 a year for lighting the streets.

Boston, Mass.—Plans for a magnificent Union passenger station in Boston have been made public. It is to be used jointly by the New England, the New York, New Haven & Hartford and the Boston & Albany and will cost about $6,000,000.

Albany, N. Y.—An ordinance will be moved for passage at the next regular meeting to be held authorizing and directing the letting of a contract for the lighting of the city of Albany by means of electricity.

Brooklyn, N. Y.—At a meeting of the Board of Alder. men, March 23, a communication was received from the Commissioners of Charities and Correction asking for the erection of a new building at the Kings County Almhouse; also for electric lighting plants, etc.

Brooklyn, N. Y.—The Brooklyn Bridge Trustees contemplate the adoption of electricity on the cars at an estimated cost of $300,000. Chief Engineer Martin, Frederick P. Strom, civil engneer, 354 Dean street.

Quincy, Mass.—The directors of the O. & B. Street Railway Co. held a meeting and voted to increase the capital stock to $165,000 and make extensive improvements to the line.

Telephone Notes.

Philadelphia, Pa.—City Councils have passed the ordinance authorizing the Standard Telephone and Telegraph Company to construct and operate a system of electric wires, conductors and cables under the streets of the city.

Cobleskill, N. Y.—The Cobleskill and Sharon Telephone Company; to maintain a telephone line from Central Bridge, to Howe's Eave, to Cobleskill, to Richmondville, to Summit, to Jefferson, to Hyndsville, to Seward, to Sharon Springs, to Sharon Centre, to Sharon, to Argusville and Cherry Valley. Capital, $1,000. Incorporators: J. B. Nutt, Judson Burhans, George W. Bellinger, of Cobleskill; J. H. Brown, of Summit, and T. K. Sharpe, of Sharon Springs.

Casper, Wyo.—Casper is to have a telephone exchange.

TELEPHONE PATENTS ISSUED MARCH 24, 1896.

556,763. Telephone-Switch. William A. Moore, Brooklyn, N. Y. Filed Sept. 5, 1895.

FOR UPTOWN TELEPHONE SUBSCRIBERS.

An uptown branch of the Contract Department of the Metropolitan Telephone and Telegraph Company has been established at 123 West 38th street (one door from Broadway), where all business relating to the supply of telephone service can be transacted as readily as at the main office at 18 Cortlandt street. There are 14,000 telephone stations in New York City. Metallic Circuit Service, Rapid, Efficient, Permanect can be had from $75 a year.

TELEPHONING FROM LAND TO VESSEL.

Washington, March 25.—The success of experiments conducted by the Lighthouse Board for establishing telephonic communication between lightships and the shore has attracted the attention of European Governments, which had failed to solve the problem after years of trial, but which now propose to take prompt advantage of the achievements of American ingenuity. The Treasury Department, upon application, has already furnished copies of the report to several foreign ministers in Washington, and the system perfected at Sandy Hook will soon be in operation abroad, while through lack of funds and the failure of Congress to make appropriations for the purpose the United States service is prevented from enjoying the benefits of its own enterprise.

CANADIAN LETTER.

BY OUR MONTREAL CORRESPONDENT.

Electric Railways.

Toronto, Ont.—J. Barrett, of Toronto, Ont., is asking permission to erect poles and wires for the purpose of transmitting power and light throughout the township of York. The electricity will be generated at the Humber.

Tavistock, Ont.—The Canadian Electric Light Co. have a gang of men at work putting up the poles in connection with the electric lights for Tavistock, Ont. The dynamo is to have its seat at the Tavistock woolen mills of J. S. Field.

London, Ont.—E. Leonard & Sons, of London, Ont., recently bought the electric light plant of the Grand Central Hotel, St. Thomas, Ont., for $520. The plant consists of engine, boiler, dynamo, poles and wires, and originally cost about $2,500.

Montreal, Que.—At the annual meeting of the Citizen's Light and Power Co., ltd., Montreal, the following officers were elected directors: R. Wilson Smith, president; ex-Alderman Lyall, W. McLea Walbank, vice-presidents; J. H. Burland, M. P. Davis, (Ottawa), J. H. Hénault, Mayor of St. Cunégonde; P. Dagenais, of St. Henri. This company is acting in concert with the Lachine Power and Light Co. It has also bought out the Standard Light and Power Co., whose rights extend all over the Province of Quebec. The company propose to put their wires underground at an early date.

Belleville, Ont.—By-laws to allow the Trenton Electric Co. to erect poles and string wires between Belleville and Trenton, and one to allow the Belleville Traction Co. permission to extend their street railway from the city to the cemetery, were recently adopted by Belleville, Ont., council.

Bothwell, Ont.—The question of installing an electric light plant is under consideration.

Alberni, B. C.—The bill incorporating the Alberni Water, Electric and Telephone Co. has received its second reading in the legislature. One of the objects of the company is to provide a water supply.

Newmarket, Ont.—The council propose submitting a by-law to raise $9,000 to put in a system of arc lights for the streets and incandescent lights for commercial and domestic purposes. The dynamos will be operated by steam-power.

Winnipeg, Man.—The city solicitor has been instructed to prepare two by-laws for submission to the rate-payers, for an electric light plant.

Superior, Wis.—The Superior and Colquet Electric Railway Co. President, M. C. S. Bright. The corporation which is to build an electric line from New Duluth on the St. Louis river, to the east end of Superior, proposes to use power developed from the falls, in accordance with the plans of three large water-power companies recently consolidated.

New York City.—Moses Adler, 33 Beekman Place, will erect a five-story brick store and tenement at 544 Sixth street, to cost $12,000.

San Francisco, Cal.—The Yosemite Valley and Merced Railway Co. Capital, $1,500,000. Directors, James B. Stetson, John D. Spreckels, O. D. Baldwin, and others.

Madison, Wis.—The Grant County Telephone Co., of Bloomington, filed articles of incorporation. Capital, $10,000. Incorporators, C. C. Marlow, L. D. Holford and Grace A. Marlow.

J. Alcide Chaussé.

New York Notes.

Watson & Stillman have for some little time been at work upon a lot of hydraulic machinery for the new American Pulley Works, of Philadelphia, which is to manufacture a new all sheet-steel pulley, in which the hub, spokes and rim are all made of thin sheet-steel.

The Interior Conduit and Insulation Company desire to call attention to their Ventilating Department now under the charge of Mr. Wm. H. A. Davidson, formerly of the Davidson Ventilating Fan Co. Mr. Davidson has been identified with the ventilating fan interests for many years, having been one of the pioneers in the art of ventilation with disk fans, and is the inventor of the Davidson and Starbuck fans.

If you are now or may hereafter be considering the question of ventilation by means of exhaust fans, we would be glad to have Mr. Davidson give you the benefit of his experience, free of charge.

The management of the National Electrical Exposition Co. have deemed it advisable to contract for an additional 10,000 ft. of space. This is due to the fact that the contracts for space have been closed so quickly that to provide for any incoming rush this provision has been made.

ELECTRICAL and STREET RAILWAY PATENTS

Issued March 24, 1896.

556,769. Electrode for Secondary Batteries. Oscar Pirsch, Liege, Belgium. Filed Mar. 11, 1895. Patented in Belgium July 24, 1894, No. 1,113,111.

556,782. Secondary Battery. Max Sussmann, Neu-Ruppin, Germany, assignor to the Electric Exploitation Company, Limited, London, England. Filed May 15, 1895. Patented in England Mar. 30, 1893, No. 6,780.

556,788. Operating Dynamo-Electric Machines in Multiple. Edmond Verstraete, St. Louis, Mo. Filed Sept. 1, 1894.

556,810. Car-Fender. Frank W. Darling, Hampton, Va. Filed Oct. 21, 1895.

556,823. Automatic Grounding Device for Electric Conductors. George A. Jewett, Chicago, Ill. Filed July 8, 1895.

556,845. Car-Fender. Ovando G. Hallenbeck, New York, N. Y. Filed Mar. 26, 1895.

556,854. Conductor for Electrical Decomposing-Tanks. John Leith, St. Helen's, England, assignor to the Electro-Chemical Company, Limited, same place. Filed Nov. 20, 1895.

556,862. Controller for Electric Motors. Edward D.

Priest, Schenectady, N. Y., assignor to the General Electric Company, of New York. Filed Apr. 9, 1895.

556,864. Trolley-Support. Emil B. W. Reichel, Gross-Lichterfelde, Germany, assignor to the Siemens & Halske Electric Company of America, Chicago, Ill. Filed Sept. 3, 1895. Patented in Belgium Sept. 29, 1894, No. 111,-897; in Hungary Oct. 26, 1894, No. 1,483; in Italy Nov. 16, 1894, No. 37,389; in France Jan. 8, 1895, No. 241,-537, and in Switzerland Jan. 15, 1895, No. 9,027.

556,865. Alternating-Current System. Edwin W. Rice, Jr., Swampscott, Mass., assignor to the General Electric Company, of New York. Filed Jan. 24, 1894.

556,866. Electric Elevator. Edwin W. Rice, Jr., Schenectady, N. Y., assignor to the General Electric Company, of New York. Original application filed Apr. 2, 1890. Divided and this application filed June 18, 1894.

556,870. Wire-Gauze Brush for Dynamos or Motors. Arthur B. Soar and Edwin W. Collier, London, England. Filed Dec. 7, 1895. Patented in England Apr. 27, 1895, No. 8,385.

556,876. Clip for Trolley-Wires. Ralph H. Beach, East Orange, N. J., assignor to the Webster & Beach, Incorporated, Boston, Mass. Filed Apr. 17, 1895.

556,882. Device for Placing Electric Blasting-Fuses. Robert H. Elliott, Birmingham, Ala., assignor to the Alabama Blasting and Mining Company, same place. Filed July 13, 1895.

556,891. Support for Field-Magnet Coils. Benjamin G Lamme, Pittsburgh, Pa., assignor to the Westinghouse Electric and Manufacturing Company, same place. Filed Sept. 4, 1895.

556,893. Electric-Car Truck. Emil Lundqvist, Pittsburgh, Pa Filed July 31, 1895.

556,898. Electric-Arc Lamp. George C. Pyle, Indianapolis, Ind., assignor of one-half to Frank H. Ewers, same place Filed May 2, 1895.

556,901. Thermo-Explosive Cartridge. Charles H. Rudd, Chicago, Ill., assignor to the Western Electric Company, same place. Filed Dec. 26, 1893.

556,902. Electrical Detonator. Charles H. Rudd, Chicago, Ill., assignor to the Western Electric Company, same place. Filed Feb. 3, 1894.

556,903. Electrical Detonator. Charles H. Rudd, Chicago, Ill., assignor to the Western Electric Company, same place. Filed Feb. 3, 1894.

556,904. Electrical Detonator. Charles H. Rudd, Chicago, Ill., assignor to the Western Electric Company, same place. Filed Feb. 3, 1894.

556,941. Trolley Attachment for Electric Cars. Fred S. Smith, Hartford, Conn., assignor to himself and Frederick C. Rockwell, same place. Filed June 11, 1895.

556,945. Regulating Device for Controlling Working of Electromotors. René Thury, Geneva, Switzerland, assignor to the Compagnie de l'Industrie Electrique, same place. Filed Feb. 3, 1896. Patented in Switzerland Sept. 7, 1895, No. 10,513.

556,946. Electric Signal-Lamp. Alexander F. Ward, Memphis, Tenn., assignor of two-thirds to Thomas S. Christie and John G. Dietz, Detroit, Mich. Filed June 21, 1895.

556,949. Safety Device for Electric Cars, Etc. Albert H. Wheeler and Joseph Gilbert, Warwick, R. I. Filed Jan. 2, 1896.

556,959. Means for Attaching and Detaching Electric Lamps. Frank A. Butterfield, Detroit, Mich. Filed June 1, 1895.

556,967. Electrical Connector. Philip H. Fielding, New York, N. Y. Filed July 9, 1895.

556,969. Car-Fender. Edward S. Graham, Philadelphia, Pa, Filed Nov. 27, 1895.

556,971. Insulated Support for Contact Rails. Augustus Hanson and James R. Chapman, Chicago, Ill. Filed Oct. 30, 1895.

556,984. Lightning-Rod Ball. Edward K. Hum, Pittsburgh, Pa. Filed Jan. 5, 1895.

556,987. Electric Recording-Instrument for Ships' Compasses and Logs. Charles L. Jaeger, Maywood, N. J. Filed Jan. 25, 1894.

557,008. Electric Trolley. George R. Mitchell, Newtown, Pa. Filed Nov. 22, 1895.

557,015. Trolley for Electric Railways. Patrick F. O'Shaughnessy and Oscar T. Crosby, New York, N. Y., assignors to the Sprague Electric Railway and Motor Company, same place. Filed Sept. 27, 1888.

557,037. Electrical Connector. Benjamin L. Toquet, Westport, Conn. Filed Dec. 28, 1895.

557,048. Zinc-Support for Batteries. Horatio J. Brewer, New York, N. Y. Filed June 9, 1894.

557,057. Process of and Apparatus for Producing Metallic Compounds by Electricity. Edward N. Dickerson, New York, N. Y. Filed June 5, 1895.

557,094. Converter of Frequency for Alternating Electric Currents. Maurice Hutin and Maurice Leblanc, Paris, France, assignors to the Société Anonyme pour la Transmission de la Force par l'Electricité, same place. Original application filed Mar. 13, 1894. Divided and this application filed Mar. 3, 1896. Patented in France Oct. 8, 1891, No. 216,620; in Germany Oct. 30, 1891, No. 72,461, and in Austria-Hungary Oct. 23, 1892, No. 20,-131 and No. 42,071.

The Electrical Age.

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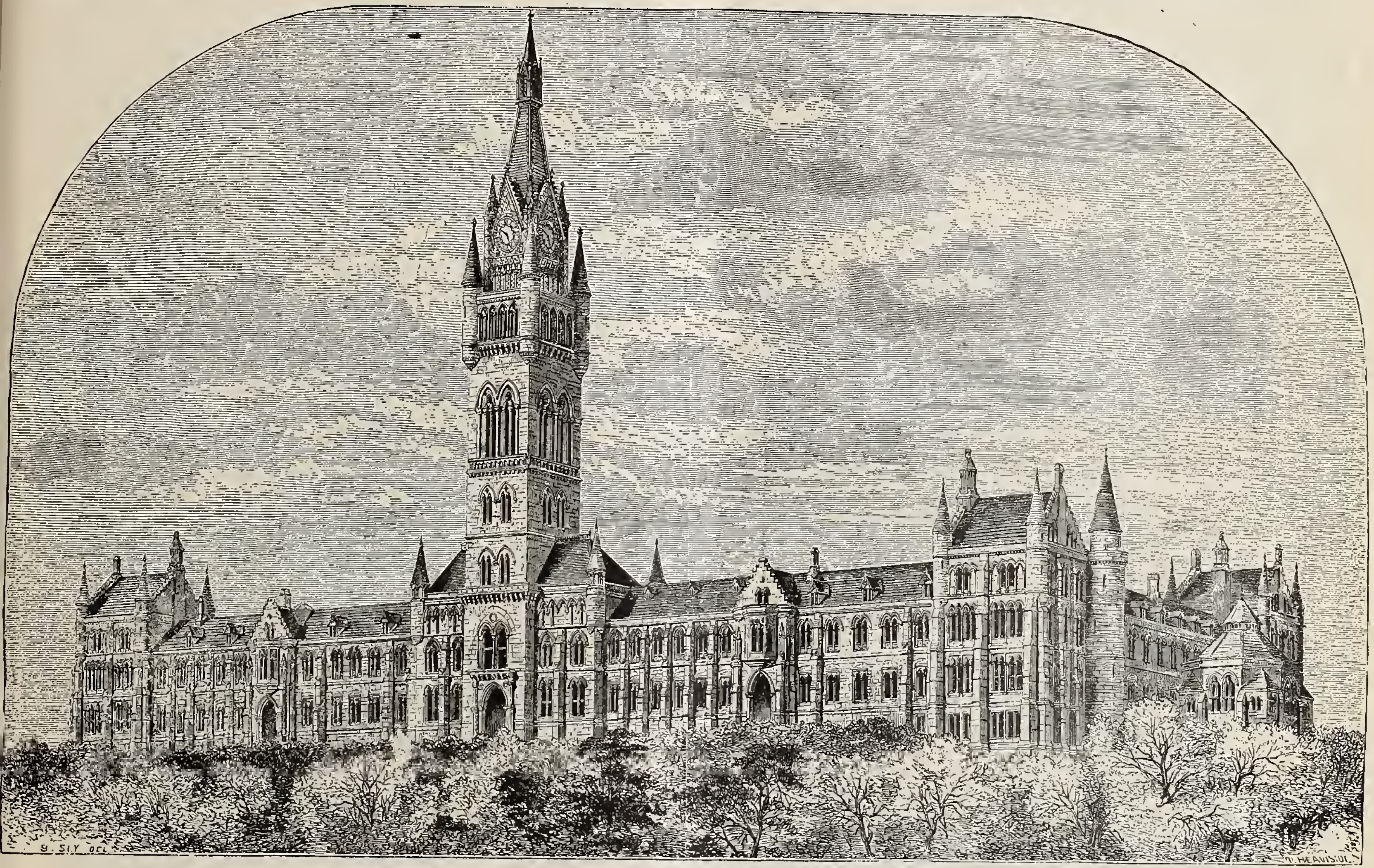


GLASGOW UNIVERSITY.

THE LIFE OF LORD KELVIN.

William Thomson, L. L. D., D. C. L., F. R. S., the most distinguished of English electricians, about to complete his fiftieth year as Professor of Natural Philosophy in the Unive-sity of Glasgow, Scotland. One who helped to lay the first Atlantic cable and through whose efforts it proved to be a success.

A man unequalled for the extent of his theoretical knowledge and whose practical inventions have made him unique as a genius of unlimited and even-handed power, made Baronet and Lord for his great services to England.

In many respects the character in whose honor this brief sketch is drawn is a type peculiarly significant of the age. Every century has produced its great men—their brilliancy, eloquence and wit winning for them the applause of nations. Yet few have lived in this double capacity of thinker and inventor, and exercised with equal facility the mental adroitness and practical application which so distinguishes the career of this eminent scientist.

Born in Belfast in 1824 his early tendencies soon manifested themselves by a precocity that even in early years placed him far above the plane of his associates. His father, Prof. James Thomson, was born in the county of Down, Ireland. His labors in the University of Glasgow in 1832 showed him to be a man of great merit and ability. He was an able mathematical scholar and no doubt transmitted many commendable virtues to his famous son.

William Thomson entered the gates of the Glasgow University when eleven years of age. He graduated from there, going to Cambridge, where in 1845 he was elected second wrangler. The young man's remarkable powers made him prominent figure wherever he moved. He was made a fellow of St. Peter's College by an admiring faculty. When but eighteen years of age he had contributed an article to the Cambridge and Dublin Mathematical Journal, "On the Uniform Motion of Heat in Homogeneous Solid Bodies and its Connection with the Mathematical Theory of Electricity." The great Regnault was still busy in Paris at this time, and the young man went abroad to study under him. When twenty-two years of age he returned to his *alma mater*, leaving Regnault and all the busy world that had been so glad to meet him to accept the chair of Natural Philosphy in this famous college.

He contributed to one of the great scientific journals of the day—*Lionville's Journal de Mathematiques*, the following articles: The Mathematical Theory of Electricity in Equilibrium; The Elementary Laws of Static Electricity.

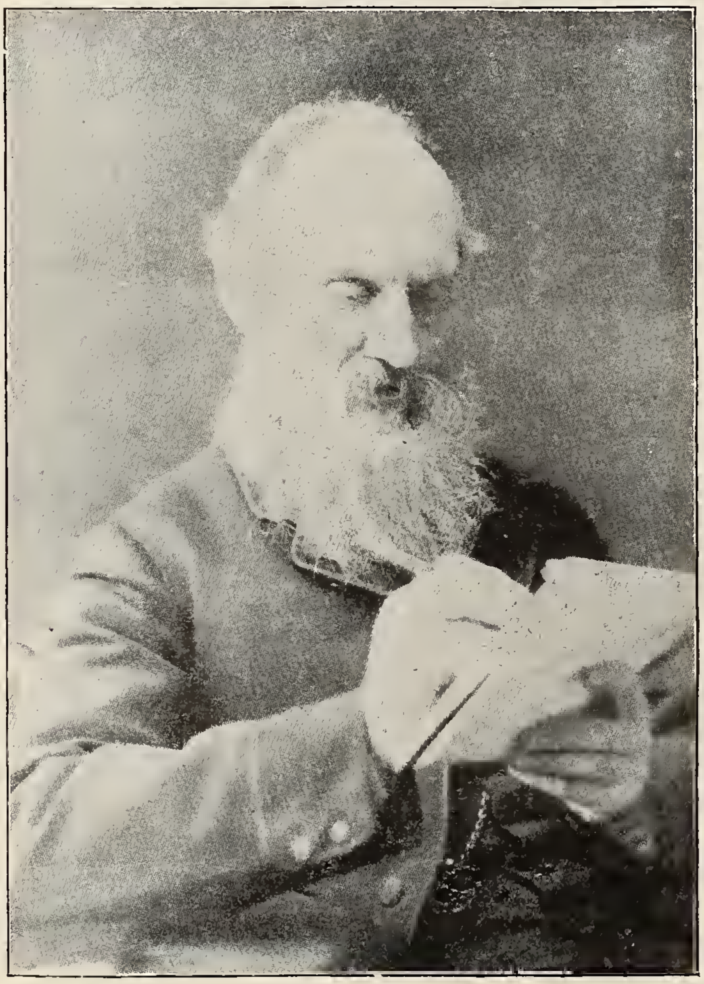
He became editor of the Cambridge and Dublin *Mathematical Journal*, and exercised so profound an influence over the scientific thinkers of the day as to obtain articles from SIR WILLIAM ROWAN HAMILTON, PROF. G. E. STOKES and PROF. ARTHUR CAYLEY, of Cambridge University and Augustus de Morgan of the London University.

This great genius seemed to delight in difficulties. In 1848 a paper was written by him "On the Distribution of Electricity on Spherical Conductors," and the famous electrometer invented. A series of papers were also written in 1849 and read before the Royal Society of Edinburgh. He was the first to place thermo-dynamics on a scientific basis.

In 1855 he was selected by the Council of the great Royal Society of England to deliver the Bakerian Lecture. The subject he selected was the Electro-Dynamic Properties of Metals.

About this time the plan was being evolved for the unification of America and England by a submarine cable and in 1858 the first practical attempt was made, which (to make legitimate use of English) was a *signal* failure. The idea was neither lost nor forgotten by this defeat, for the possibility had already been strikingly illustrated. Lord Kelvin at once directed his energies to the problem with redoubled force and attention.

While reflecting over the difficulties in the way of cable telegraphy more honors were received by him. In 1862 he won the Keith prize given by the Royal Society of Edinburgh. His papers on "The Mechanical Energy of the Solar System," and "On a Universal Tendency to the Dissipation of Mechanical Energy" could hardly establish the fact more thoroughly of his pre-eminent power. Sir David Brewster, vice-president of the Edinburgh Society, in speaking of Thomson's work, said "These papers evince a genius which has not been surpassed, if equalled, by that of any living philosopher." The work of Faraday, in 1854, relating to the retardation in cables formed the basis of his investigation. He discovered the great Law of Squares—that the retardation in cables is proportional to the square of their lengths. The invention of the mirror galvanometer made the next trial of trans-Atlantic signalling in 1863 much more successful.



LORD KELVIN.

T. COMERFORD MARTIN.

In 1866 the great work was accomplished and the established system of cable telegraphy has since then continued. The inefficacy of the mirror galvanometer led to the invention of the siphon recorder for the reception of messages, and thus completed the chain of devices called into being for the operation and success of this gigantic enterprise. England honored him by a knighthood, and the name Sir William Thomson has spread far and wide.

Oxford showed its respect and esteem by extending to him the title of D. C. L., and Cambridge, in 1866, made him an L. L. D. The university of Dublin had already honored him with a degree of Doctor of Laws as far back as 1857.

All means by which the world could show its appreciation of him were taken. St. Peter's College of Cambridge, in 1872, re-elected him a Fellow.

Thus it is that modern heroes are honored. Loved by his own people and admired in all the countries of the globe he has truly reached the very pinnacle of fame. To be made a Lord was but an incident in comparison with the brilliant past. The great orginality of the man and the exactitude of his methods place him amongst the intellectual kings of the day.

As a theoretician of clear insight his work has seemed to be one of intuition. The practical applications he has made of each crystallized gem of knowledge places this extraordinary man upon the throne of perfection. How many have labored as he has and spent the sunshine of their lives in such prolonged observations? How many can grasp the minutiæ of fact so comprehensively and deduce with such rigid logic the hidden laws of nature? Amongst the immortals surely his name shall find a place. For in his deeds and life he shines with the splendor of the noon-day sun.

" Of all the gods, I only know the keys
That ope the solid doors within whose vaults
His thunders sleep.

LORD KELVIN.

National Electric Light Association,
126 Liberty Street, N. Y. City,
April 1, 1896.

The following communication has been received at this office:

Jubilee
of the
Right Honorable Professor, Lord Kelvin,

Glasgow, March 10, 1896.

Sir:—In the autumn of this year the Right Honorable Lord Kelvin completes the fiftieth year of his tenure of the chair of National Philosophy in the University of Glasgow. An event so rare in academic history naturally calls forth the heartiest congratulations of the University and the city; but, in view of his pre-eminent position as a man of science, it has been thought fitting that other Bodies who have already testified their appreciation of Lord Kelvin's distinction by enrolling his name among their members, should be invited to take part in the proceedings with which it is proposed to celebrate the Jubilee of his Professorship.

We are desired by the Committee charged with the arrangements to intimate that the University and the Municipality would be gratified by your appointing a Representative to take part in the celebration to be held here on the 15 and 16 of June next. Be so good as send to Professor Stewart, clerk of Senate, The University, Glasgow, not later than April 10, the name and address of your representative in order that a formal invitation may be forwarded to him.

We have the honor to be, Sir, your obedient servants,

John Caird,
Principal and Vice-Chancellor of the University.

James Bell, Bart,
Lord Provost of Glasgow.

It gives me pleasure to state that President Wilmerding has appointed Mr. Thomas Commerford Martin to represent this Association on this occasion.

Very truly yours,
Secretary.

PRINCIPLES OF DYNAMO DESIGN.

BY

Newton Harrison, E.E.

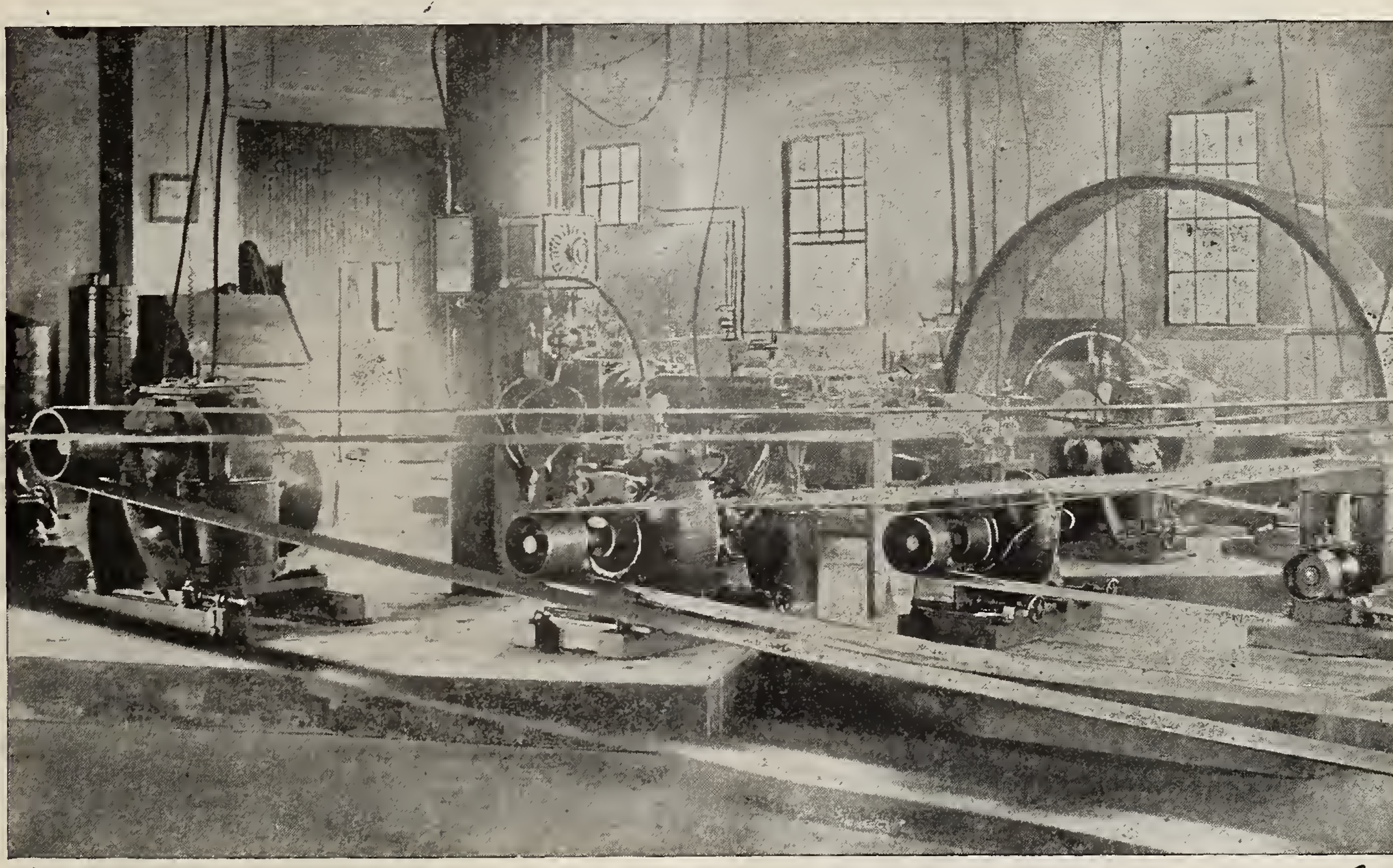
(*Continued from page* 138.)

The numerous types of machines manufactured by leading companies may be aptly represented as a means of showing the diversity of opinions existing regarding the so-called best type of frame.

The many changes through which both bipolar and multipolar machines have passed, and the persistence with which even the most unusual styles have continued, seems at times to oppose the familiarly accepted principle of the survival of the fittest.

It is an advantage to have the armature and its necessary accompaniments within easy access. By having the field near the ground the dynamo tender in charge is forced to bend, in order to accommodate his body to the part under inspection, treatment or repair. Therefore, in many cases, builders of machinery have taken this fact into consideration and brought the armature as high as was consistent with the preservation of its stability. This cannot be done, however, in the case of many dynamos without unduly elevating the machine as a whole in the air and thus endangering its position, the rigidity of which is so essential to its successful operation. There is a noticeable difference between various frames in this respect, such that one may be selected whose centre of gravity is low, stability of position assured, and commutator and brushes within immediate reach of the hands.

The inverted horseshoe is the style referred to, the yoke of which supplies a base plate by extension for the bearings as well as the machine itself. The fields, if not situated too high in the air, will allow the armature to occupy a position satisfactory to the most careful critic. Aside from these considerations of support there are other motives that have led manufacturers to adopt special styles. The entire lack of protection to the coils of an ordinary dynamo has proven a source of evil to many consumers. A careless engineer will strike the fields accidentally with a wrench or abraid the winding in an equally unintentional



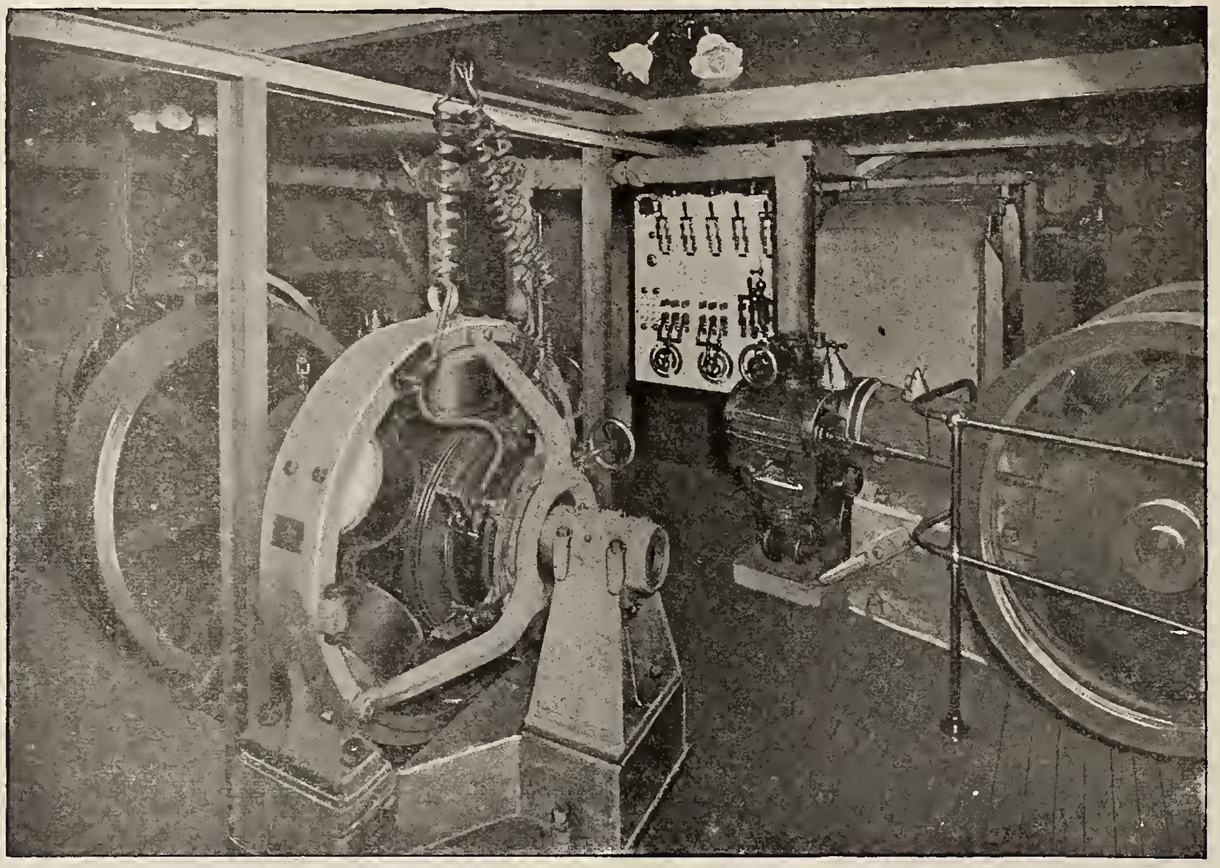
ELECTRIC LIGHT PLANT SHOWING DIFFERENT TYPES OF MACHINES.

Electric Welding.—The welding of bicycle tires by electricity is now carried out very satisfactorily. A weld can be made in five minutes, which, by the ordinary process, would take two experienced men half an hour. Another process, says *Lightning*, is the electric welding of printers' chases, with the added advantage that, thanks to the heat being so local, the interior of the chases can be finished in a milling machine before welding, instead of being laboriously finished by hand afterwards. Another interesting operation is the welding of two metal plates with their planes at right angles. The edges are brought together under pressure, and on the current passing they eat into one another and are welded together at the same time.—*Trade Journal Review.*

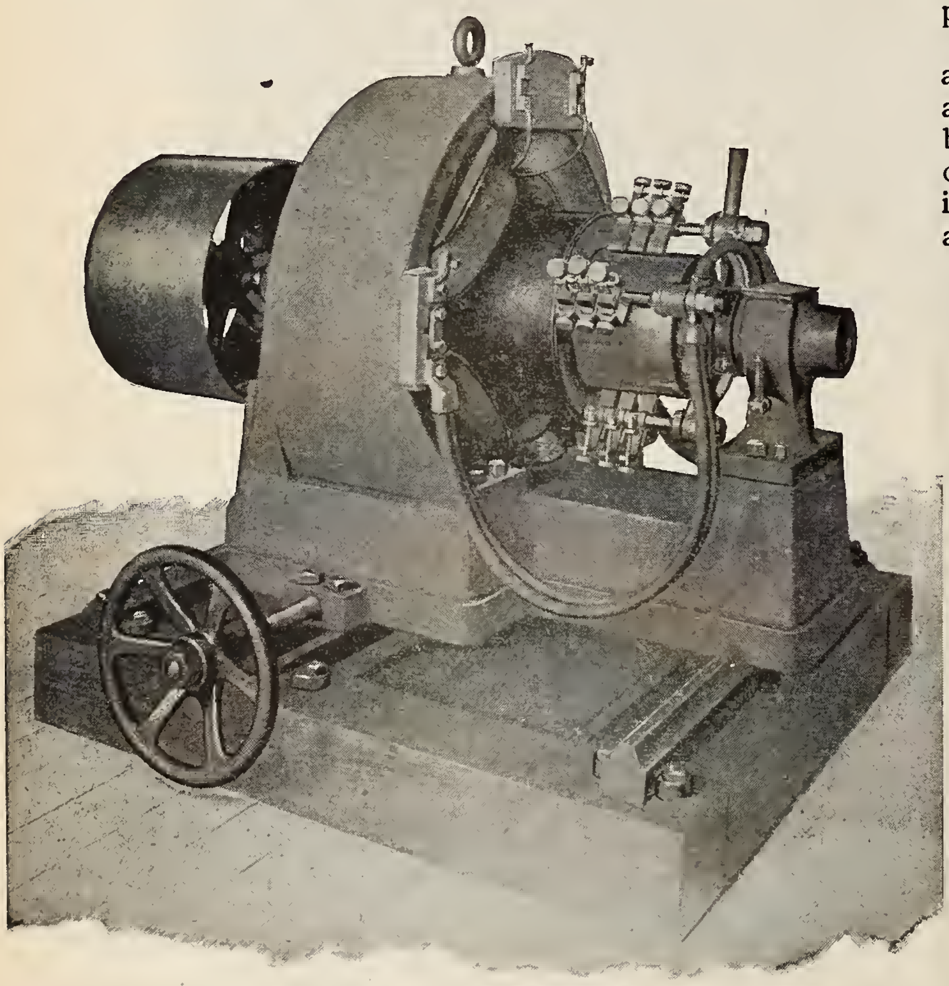
Carborundum.—The silicide of carbon, or carborundum as it is called, is likely to come into use as a material for making the filaments of electric incandescent lamps.

Geo. W. Mills, of the New York Carbon Works, 39 Cortlandt street, New York city, has just returned from an extended western trip. He reports business in excellent condition.

manner. The most prominent surface on many machines is the exterior of the fields, and any ill-treatment to these due to infiltrating oil or accidental blows will surely prove a source of immediate or future trouble. By protecting the fields, not by a covering—for then the radiation of heat would be interrupted—but by using a frame such that the coils are protected by the overspreading frame, the object sought is easily attained. The iron-clad frame would satisfy those desiring such provision for the protection of that part and the elimination of such a possible source of injury.



A MARINE PLANT.



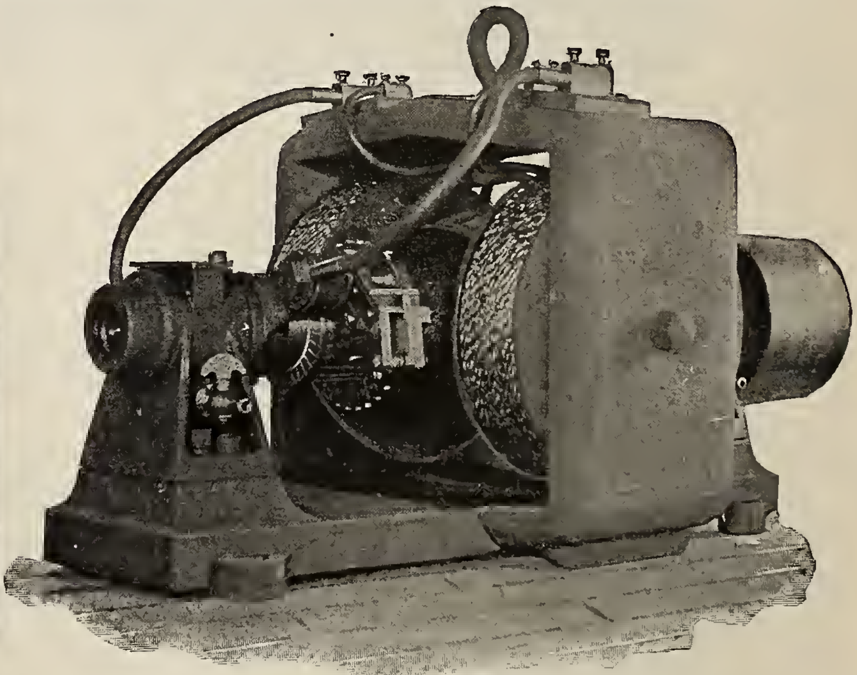
MULTIPOLAR MACHINE.

In many other respects the iron-clad machine is in a sense superior. The leakage, magnetically, is entirely within, and the machine as a machine is a most substantial type.

In fact, for railway work the points thus enumerated are very important in the eyes of railway engineers, as the gravel and dust of transit make short work of any exposed part. Frequent attempts to substitute other types successfully have failed, and the iron-clad machine is now being manufactured by prominent railway concerns.

Multipolar types have gradually spread upon the market as an improvement over existing forms. The lightness in certain cases makes it highly commendable, and its slow speed frequently sanctions its introduction where all else would fail. Large Edison stations are now equipped with multipolar generators, and it seems that they represent the perfected type of the best engineering practice.

Even for small sizes, where it would seem best to utilize another type, they are used with perfect satisfaction. As a rule, for units of less than 20-K.W. bipolars are employed, but beyond this the prevailing design is multipolar. Direct-connected plants in this case are quite a common feature of isolated as well as central station lighting. For motors, and especially when a very slow-speed is necessary, multi-



IRON-CLAD BIPOLAR.

polar machines assume the first position. Marine equipments are never complete without them—and the absence of care and lack of wear have made them a boon to many an engineer in charge of a large plant.

(*To be Continued.*)

The Electrical Age.

Established 1883.

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NEW YORK, APRIL 11, 1896.

CONTENTS.

FIFTY YEARS OF SERVICE.

Lord Kelvin, in common with many noted men of England, has shown an aptitude for work which is remarkable. It would seem that half a century of active life of the most trying nature would weaken the system, impair the energies and affect the power of protracted thought. Such signs have not yet appeared in this vigorous frame. He does not, like Gladstone, hew his annual tree But he concentrates his power on many a worthy problem with unfailing will and resolution.

He does not engage in the active pursuits of the day. But removed from the noise of commercial activity in the centre of his beloved college he wields the sceptre whose magic touch infuses much new and useful knowledge.

Great in the dignity of his position, greater still in the hearts of his dearest friends, surrounded by the sons and grandsons of his former associates, he continues his useful and honorable career.

Few men have enjoyed so illustrious a past and shown, in combination with so active a mind, as great a fund of practical resources.

The Atlantic cable felt the influence of his inventive genius; by his persistent efforts becoming an engineering success. In countless other ways the activity of his mind manifested itself. The pathways of science were strewn with nuggets which required his discerning eye to select. Much that is not seen and never will be known surrounds the lives of great men. Their deeds cannot be hidden; they are the fruits of an irrepressible genius. But the habits of their daily lives, the character that has made them admired as men should never be forgotten.

MODERN ILLUMINANTS.

The homes of today realize in their luxurious fittings the dreams of Eastern monarchs. Not even a wave of the hand is required to provide the assistance of willing slaves —that labor has been reduced and a touch of the magic button supplies at once the light of day, the hastening servant and the message to our distant friends. The home is well equipped with conveniences that take labor from our hands and smooth from our path those everyday trials that so weary the self-indulgent man of leisure. Let us glance at these greatest blessings of the times, our modern illuminants, and peep into their early history.

In Scotland the light of the hearth helped Robert Burns compose his sweetest poetry. The sputtering candle flame was a close and familiar friend to Nathaniel Hawthorne, and the yellow gaslight, with its prosaic surroundings, supplied Charles Dickens with a never-failing theme.

The illuminants seem to mark the periods of the age and stamp them with a force and color that never departs from our minds.

The later inventions have been rapidly spreading, and the arc, the incandescent and the gaslight are now the most familiar features of present city life.

Are these the whole of our modern illuminants? It would not be justice to many indefatigable workers to thus deny their labors. There is another greater, far surpassing illuminant slowly coming to the front. Nicola Tesla is trying to give us the glories of dawn when the magic button is touched—trying to leave the old, wasteful methods far behind and simulate the *beau ideal* of modern illumination, the light of biblical diction, the lamp that burns without a consuming flame.

DAMAGE FOR CROSSED WIRES.

The Honorable Justice White, of Quebec rendered a decision against the Sherbrooke Telephone Association charged with having allowed their wires to cross the lines of the Richmond County Electric Light Co. and thereby burning out a dynamo at the plaintiff's station.

The arguments seemed to hinge directly upon the possibility of injury to the dynamo by troubles within itself, or those due to a prolonged and heavy flow of current resulting from the cross outside. The circumstances are not as unique as the case. It is a frequent source of trouble in towns with overhead wires. Until lately New York was a vast cobweb of crossing lines. Carelessness displayed during installation may lead to this difficulty.

Or the predictable and inevitable sag of the wire may in spite of all other precautions give rise to this trouble. A company is responsible for the care of its lines and by an occasional survey can keep in check or make provision for the stretching wires. By crossing the mains of a lighting company, due to thus gradually heralded evil, both companies are to blame. The lighting company for the negligent inspection of its lines, the telephone company for permitting the fault to grow. A fuse is a protection in spite of adverse opinions; is relied upon and is used as such every day.

The cross evidently caused the injury, but extenuating circumstances may be brought to light by further investigation.

At any rate it will be a lesson to the telephone company to take better care of its lines in the future—to the lighting company to buy better fuses.

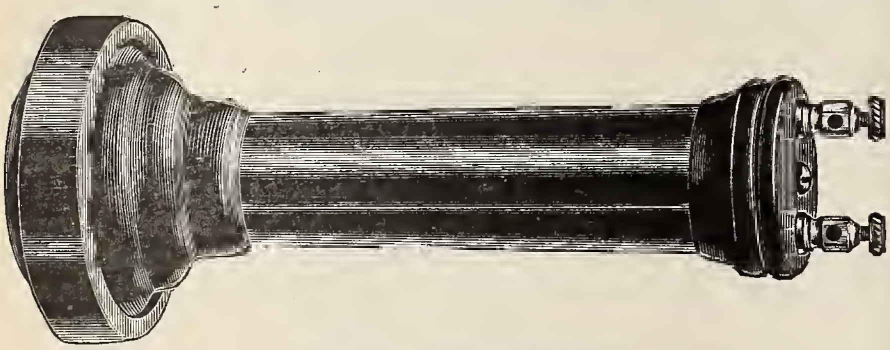
THE TELEPHONE.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

The Receiver.—The invention of the telephone has added greatly to the comforts of civilization by making communication rapid and easy and facilitating business transactions to an extent previously unimaginable.

The simple principle of its action has been a source of surprise to the novitiate, and the ingenious methods by



ORDINARY BELL RECEIVER.

which it is possible to throw in and out subscriber after subscriber from a telephone switchboard is truly admirable.

The most prominent figure in the field of telephony is Graham Bell. After him follow the names of Berliner and Edison, as inventors of valuable additions to the original idea. A vibrating diaphragm is the basis of most acoustic instruments. The purely acoustic telephone consists of a piece of stretched membrane across a hollow drum with a cord or wire connecting both.

The vibrations of the voice striking the diaphragm are transmitted along the wire to the other receiver and there distinguished. The parts constituting a system are, therefore, the

Transmitter,
Receiver,
Line.

In the ordinary form of Bell telephone the parts composing the whole are three, namely:

Permanent magnet,
Coil of wire,
Diaphragm of iron.

The rod of magnetized steel is placed in a convenient receptacle and a coil of fine wire slipped on one end. The diaphragm is mounted in front in close proximity to the end of the magnet, and a mouth-piece placed so as to focus the sound on it. There is little difficulty in transmitting speech over several miles distance by such a system. In the practice of telephony the Bell telephone is simply used as a receiver for the sound and a somewhat different device used as a transmitter. Reference will be made to this shortly. The receiver, such as it has been described, depends for its action upon a very simple principle. The vibrating diaphragm disturbs the magnetization of the permanent magnet, as follows: When moving nearer to the magnet it increases the permeability of the field and in a corresponding manner decreases it when it moves away. The field is therefore varied in a corresponding manner, and to so definite an extent as to cause these changes to affect the coil surrounding the magnet. It may be stated at once as a fact in science that the movement of a magnet in the neighborhood of a coil has an immediate effect upon it developing an E. M. F. in its turns. This physical fact is the basis of the action in a telephone.

The vibrating diaphragm varies the magnetic field of the magnet, the coil placed on its end is at once affected and very small currents are set up in the convolutions.

The instrument at the other end is perfectly similar in construction and reproduces the vibrations again in its diaphragm, due to the fact that its coil connects with the other coil and all currents set up in the first at once affect the second, attracting and releasing its soft iron in perfect accord with the other.

There is in this simple principle the basis for an investment of twenty-five millions of dollars, which today represents the capital of the Bell Telephone Co. While the delicacy of the Bell receiver cannot be doubted, it is not effective over a long line.

De la Rue estimates the current as not exceeding that which would be produced by one Daniell's cell in a circuit of copper wire one-sixth of an inch in diameter, of a length sufficient to go 290 times around the earth.

Siemens, a distinguished electrician of Germany, does not think that more than $\frac{1}{10000}$ of the entire sound the transmitter receives is reproduced by the receiving instrument, and Roentgen concludes that no less than 24,000 currents are transmitted in one second by the instrument.

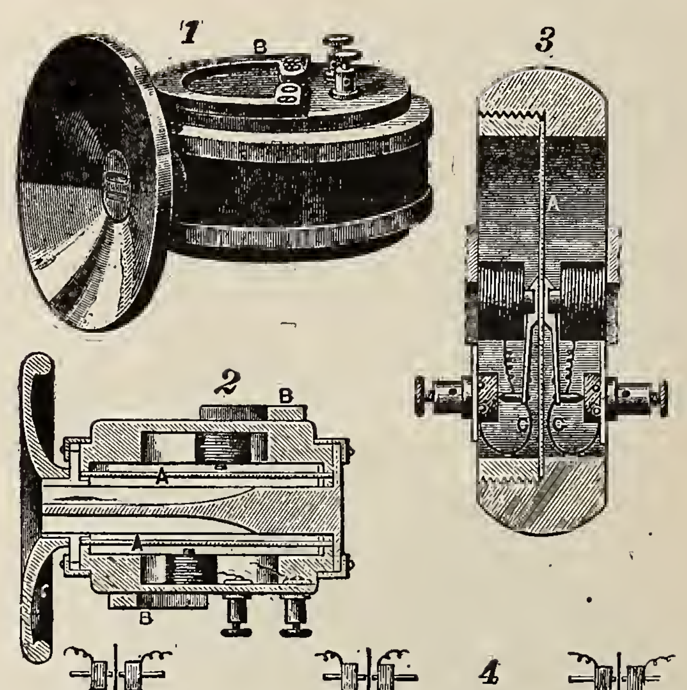
The extreme delicacy of the device employed needs no further discussion here, yet it is at times surpassed in this respect by the unequalled sensitiveness of the line itself to external influences of an electrical nature. The diaphragm can be dispensed with and a clear sound heard through the remaining parts.

This is simply cited as an experiment, not as the usual practice.

A rod of soft iron can be used instead of steel for the core of the coil. This necessitates the use of a battery in circuit, which would otherwise be dispensed with.

There is no doubt that the telephone is extraordinarily sensitive, and may be used for the detection of currents which would otherwise escape notice.

Contrary to the expectation of practical men the telephone works best with a diaphragm of ferrotype iron instead of very thin iron. The extreme susceptibility of the



A DOUBLE DIAPHAGM RECEIVER ON THE BELL PRINCIPLE.

receiver places it in excellence far beyond any of the acoustic inventions of the age.

The microphone.—Before explaining the details of construction of the modern transmitter is necessary to understand the principle of the microphone, of which the transmitter is simply a development.

This peculiar piece of apparatus was invented by Prof. Hughes, and depends for its action upon the change of resistance in two pieces of carbon placed loosely in contact, and forming part of an electric circuit in which is included a Bell telephone receiver.

Two blocks of carbon are slightly hollowed out to receive between them an upright piece of carbon pointed at each end.

Pocket Phonograph.—A pocket phonograph, measuring only six inches by two inches, is a new French invention, said to work perfeclty.—*The Trade Journal Review.*

THE NON-BLACKENING TWO-BULB LAMP.

PATENTS APPLIED FOR.

WE present to our readers in this issue an incandescent lamp, in which some absolutely new and evidently progressive features have been introduced. These new features have in part the purpose of greater economy in the manufacture of the lamp and in part the purpose of obviating the blackening of the inner face of the exhausted bulb.

When all parts belonging to the lamp are ready, the fitting of the lamp requires the following successive manipulations, and no others, namely:

1. The fusing into the glass-thimble *a* of the inleading wires.
2. The mounting thereon of the filament *b*.
3. The fusing of the thimble *a* into the neck of the vacuum-bulb, and into the opened nipple of the base *B*, the two joints adjoining one above the other on the tubular thimble.
4. Slipping the open bulb *C* over the exhaust-tube *d* of the bulb *A*, to the effect of bringing the bulb *C* to join at e, e' the base *B* by means of a water-glass joint.
5. Expanding the tube *d* at *f*.
6. Exhausting the vacuum-bulb *A* and closing *f* by fusion.
7. Piercing the base *B* in the wart *g*, leading one wire through the aperture and the other through the tube-stump *h*, slipping on the threaded metallic contact-ring i, i', if used at all, and the metallic contact-cap *k*, and soldering, as required.

The cost of the lamp can be brought to a minimum, by causing the bulb *A* and the base *B* to be made in one in the same mould, and by dispensing with the threaded contact-ring. But this saving will result in the loss of quality in the lamp.

As best proposed the base *B* is made separate, in bottle-shape of white opaque light-reflecting glass. It not only then performs the function of adapting the lamp to all classes of sockets, by its selected form of cylindrical end, but performs also the two functions of reflecting light, that otherwise would be uselessly radiated, and of insulating the inleading wires without any other means, such as plaster of paris, or an insulating button.

If the contact-ring i, i is dispensed with, the wire-end at g must be secured by means of a small solder-button, to thereby make the contact with the socket, because, as in the illustration shown for the Edison socket, the all-glass base is in all cases adapted to the socket that the lamp is intended for.

None of the seven manipulations required is foreign to the present method of manufacture, though one, the first, is slightly modified in its process on account of avoiding compression as the means of sealing.

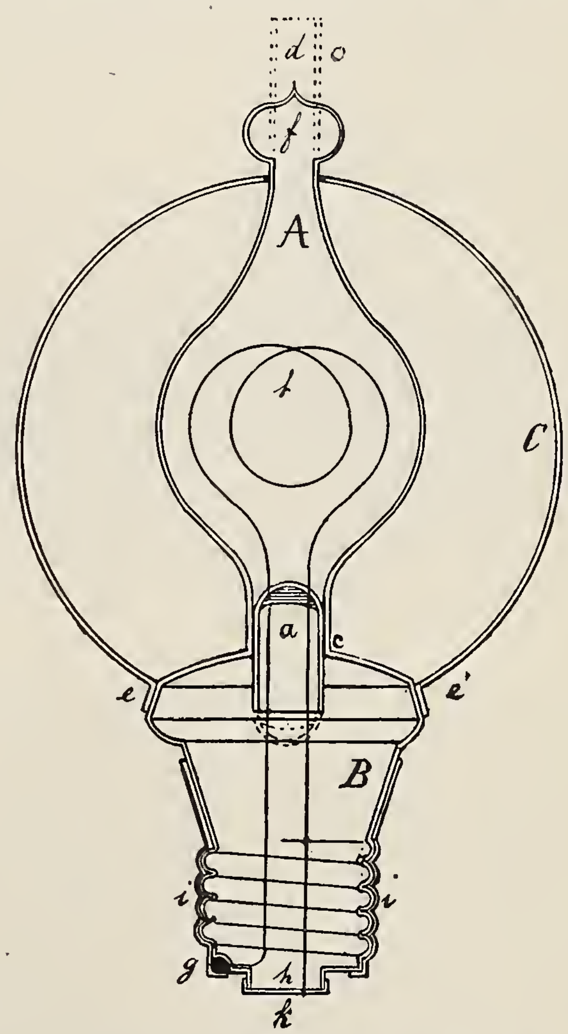
The glass thimbles of required length are made of tubing and are, without being allowed to cool, pierced for the wires, provided therewith and sealed on them without change of outline. And this is perfected by running a small quantity of hot powdered glass of adequate quality into the hot thimble around the wires, and by then fusing this extra supply of glass with the thimble end and on the wires, without modifying the butt of the thimble in its outline. The quantity of extra glass used is not large enough to fill the thimble to, including the space, where it will be joined by fusion and expansion eventually to the vacuum-bulb *A*.

The fusing of both, viz., the vacuum-bulb and the base, the latter by means of its opened nipple *c* to the thimble, is perfected in the same operation, the two joints adjoining one another on the thimble-face.

The water-glass joint between the air space bulb *C* and the base *B* occasions less work or expense than the obviated use of plaster of paris would. The change results in a lower percentage of wasted parts and of waste-lamps, in the course of manufacture, and by means thereof reduces the original cost per lamp sold to even less than that of the common vacuum lamp.

While there are shown in this lamp many economical features and, it may properly be said, features of artistical beauty, and of simplicity of structure and manufacture, these do not constitute the lamp's chief merit.

There is this entirely new feature in this lamp, that it has a second protecting glass-bulb around the exhausted bulb, and has it for a definite and important purpose, namely, for the successfully achieved purpose of obviating by its instrumentality the deposition of matter on the inner face of the exhausted bulb; for the successfully achieved purpose of keeping the candle-power of the lamp up to standard, not only during its youthful age, but during its entire lifetime. And this purpose is achieved by an exceedingly simple contrivance. The main and major part of the exhausted bulb is kept at high temperature, but not high enough to make it red-hot and opaque, by the air-space and extra-glass bulb surrounding it. But a small or minor part of the exhausted bulb is kept outside of this extra bulb and exposed to the cooling influence of the atmosphere. It is in consequence of differential cooling and deposition of vapors that the substance, which in the ordinary vacuum lamp deposits all over the inner face of the exhausted bulb and darkens it, colors it and lessens its transparency to light, and diminishes the candle-power of the lamp during a considerable portion of its life, is in this new lamp made to retire into the seclusion of the harmless hollow button, *f*. That cooling effect does in fact cause locally increased deposition, is a matter of every-



CAZIN'S NON-BLACKENING TWO-BULB LAMP.

day experience. Incandescent vacuum lamps exposed to air-draught from often open door or window, and the position of which lamps is not changed, show always increased deposition and blackening on the exposed side of the bulb.

It is true that some nice theories have been advanced, other than evaporation and condensation, but the causes quoted for these theories do on investigation not hold good. The spoiled filament under the microscope is not different essentially from the filament used, as it appeared previous to being flashed to the intended resistance. It is the product of the flashing which volatilizes mainly, the deposited substance being mainly the same as the substance deposited on the filament by and in the flashing process, a fact of which advantage is also taken in the new lamp, by preparing the filaments therefor at a reduced rate of flashing.

It is not claimed that the additional bulb prolongs the life of the lamp beyond what is the result of its additional protection given to the exhausted bulb under subit cooling, but it is claimed that the aggregate light-power of the lamp during its life is increased for not less than forty per cent., unless the lamp of the older form be discarded, when otherwise yet fit for service, on account of loss of light efficiency. And it is claimed that the additional glass bulb to be passed by the luminous rays does not cause loss of light in the operation of the lamp, but that, for causes not as yet fully explained, the retaining of a higher temperature in the lamp proper and in the filament more than compensates for the loss in passing the second bulb. The deposit concentrating button is so placed, and is of so small dimensions, that it does not perceptibly intercept the aggregate radiation of the lamp, even when it has become covered inside with lamp-black. To keep up appearance, even in that case, the button, f, is either frosted or is made opaque by other known means.

The patentee, well-known to our readers by his contributions to Electrical Age for many years on various scientific subjects, Mr. F. M. F. Cazin, of 1027 Washington street, Hoboken, N. J , proposes to hand over to lamp manufacturers the patented parts of his lamp to let them try its make and its virtues for the purpose of either arranging for an exclusive license to one, or of licensing and making sale of parts to all. It is proposed to reserve the use only of the patented features of this lamp for the same patentee's other new lamp, the luminous body incandescent vacuum lamp, which is now being brought to its practical shape and perfection.

In this other new lamp, of which we shall further speak on another occasion, the same substances, the oxides of thorium and cerium are used that form the webs in the Welsbach gas lamp for increase of light, in form a sheet or body, in or on the face of which the filament or filaments appear as an integral part, and which sheet, manufactured under new methods, is made incandescent by the dark heat-rays emanating from the filament or filaments under current. And the reserve is made because the double globe and local deposition is applicable to the luminous body lamp, the same as it is to all other incandescent vacuum lamps.

The two-bulb lamp and its parts may be inspected at 173 Broadway, in the office of the American Equipment Company, O. S. Burr, pesident.

DAMAGES FOR CROSSED WIRES.

The Montreal Daily *Star* publishes the following details of an electrical case which sets a precedent in the Canadian courts with reference to damages sustained, as the result of crossed wires and short circuiting. Hon. Justice White rendered an important judgment at Sherbrooke, Que., in the case of the Richmond County Electric Light Co. *versus* the Sherbrooke Telephone Association, condemning the defendants to pay plaintiffs $218.63, on account of the wrecking of a dynamo at the plaintiffs' station, through the act of the defendants in allowing one of their wires to cross the plaintiffs' and produce a short circuit.

There was a fuse placed on the plaintiffs' line, which was designed for the protection of the dynamos in the station; but this did not blow, or melt, at the time of the cross. The defendants contended that the fuse was an absolute protection, and that if there had been a short circuit outside it surely would have blown; consequently the wrecking of the machine was caused, not by a short circuit from outside, but by the defective construction and state of repair of the machine. Judge White ruled against this pretension, discounting the evidence of the experts, who, he said, were always interested in favor of the parties summoning them. More reliance could be placed upon the opinions of the electrical engineers, members of the American Eleotrical Institute, who had recently met to discuss this very subject, at Niagara, where the distinguished electrician, Walter E. Harrington, closed his paper with these words: "The natural conclusion arising from the knowledge of the above data is that fuse metals are, under no circumstances, to be considered in the light or nature of a protection." Out of the nine experts who joined in the discussion, not one of them expressed an opinion that the fuse is an inevitable protection. One of them said it was "in most cases;" another said it was "in some cases;" while Mr. Harrington was of opinion that in no case could it be absolutely relied upon as a protection.

Judge White held the evidence adduced shows, in this case, that the injury to the dynamo could have been so caused although the fuse did not blow; that the damage resulted from the contact which it was established had taken place, and that the defendants were to blame for that contact.

The judge observed upon this latter point: "That the space required for the safe enjoyment of the plaintiffs' rights as a prior occupant, were dangerously encroached upon by the defendants in 1892 when they strung their wires; and that, even if the sagging of their primary wires at the point of crossing was somewhat less in January, 1895, than it was in 1892, it has not been brought about by any improper or illegal action committed by the plaintiffs, but that the contact took place through the dangerous proximity in which the defendants' wires were originally strung there, and from the sag which has slowly and continuously gone on till they came into contact." Other points were cited, and His Honor concluded by stating that the municipal authorities of Richmond should have a more active supervision over such dangerous places, and he had no doubt that, if the plaintiffs had sought for an order against the defendants to compel them to remove their wires to a safer distance, the Court would have felt obliged, under the evidence adduced, to grant that order.

The defendants express their intention to immediately appeal from the decision of this Court.

INQUIRY COLUMN.

In this column we shall endeavor to answer all questions relating to the science of electricity that may arise in the minds of our subscribers.

(*Q.*)—Arc Lights.

New York, April 1, 1896.

Dear Editor:—Can you tell me in your next issue whether the arc light uses up very much air in a room? By answering the above you will greatly oblige,

Yours respectfully,

James Elwood.

(*A.*)—An arc lamp consumes some of the oxygen of the air, but in very small quantities.

The heat of the arc burns the air, as it were, a portion of the incandescent carbon particles combining with the oxygen to form carbonic oxide, etc. From a hygienic standpoint it is only surpassed by the incandescent lamp.

(*Q.*)—Grounded Line.

New Jersey, April 2, 1896.

Electrical Age Publishing Co.

Dear Sirs:—If not asking too much, I should like to take advantage of your valuable columns to have this question answered: An arc line is grounded at one point near the middle of the line—how can the troublesome effect of it be removed even if the ground itself is not?

John Connor.

(*A.*)—If the ground is severe and affects the plant it should be removed. There is no way of removing the troublesome effect otherwise.

Note.—Professors Puffer and Pupin's articles will be continued next issue.

ROENTGEN RAYS.

Phosphorescent Light.—Plücker found that the light of a Geissler tube did not depend on the substance of the electrodes, but simply on the nature of the gas or vapor in the tube. The discharge of a coil in a perfect vacuum is an impossibility, while the same discharge passes freely through a tube containing highly rarefied gas. It therefore follows that the presence of a ponderable substance is absolutely necessary for the passage of electricity.

Geissler Tubes to Medicine.—The light of Geissler's tubes has been applied to the practice of medicine. A branched tube is used, the single point of union being used when aglow for the exploration of intestinal tracts.

Interesting Facts in Science.

Conversion of Emery into Corundum.—Mr. Hasslacher has patented an electric process of converting emery into corundum by means of the arc of alternating currents. As heat and not decomposition is aimed at, continuous currents would be unsuitable. The furnace is made of firebricks and stands on two bridges; the hollow underneath serves as receptacle for the fused mass, there being a small hole in the bottom of the furnace. This hole is covered with a glass plate. The electrodes (carbon rods) are approached to within one or two inches; the interval is packed with lumps of carbon. The emery, also the finest dust of little use otherwise, is mixed with powdered coal, the amount depending upon the iron oxide in the emery; for 25 per cent of oxide five per cent. of carbon is reckoned. The coal lumps are soon burned by the oxygen of the iron oxide and the arc forms under hissing. The inner mass begins to melt, the glass plate gives way and a stream of fused corundum flows out. The hard outer crust is then broken with iron rods and new material thus fed to the arc. This addition stops the flow, which starts again after ten or fifteen minutes. The base plate is strewn with fine emery powder to protect it from the intense heat of the fused mass. The resulting corundum is almost free of water, of which the emery contains about five per cent. It is crystalline, colorless, and then resembling quartz, pink or blue; fine, small crystals of sapphires have been found in druses. The current is kept at 250 amperes and 40 or 60 volts.—*The Trade Journal Review.*

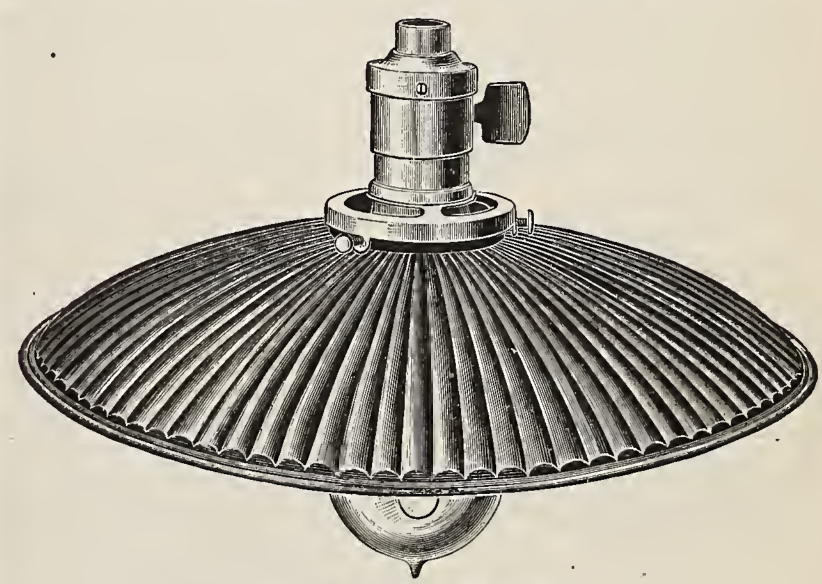
We note in an English journal the following, which partakes of the character of a criticism:

Formula for Condensers.—Prof. Harold B. Smith contributes a short note to the February number of *Electric Power* on the subject of the construction of a condenser. A given capacity is wanted, and it is required to find the size. Starting from the theoretical formula for the capacity, $kA/4\pi d$, where k is the specific inductive capacity of the dielectric, A the area of the plate, and d the distance between the plates, it follows immediately on expressing the capacity in microfarads that the required area, A, is given by the equation $A = 1.1313\ C\ d \times 10^7/k$, where C is the given required capacity. The value of k of course varies from unity in the case of air to as much as 5 for mica. (It is a quantity by no means accurately determined for most substances.) As a practical example, suppose it is necessary to design a condenser having a capacity of 1.5 microfarads with a dielectric of oiled paper 4.3 mils thick and tinfoil 7 mils thick, since the value of k for oiled paper is 2.67, the equation given above becomes $A = 1.1313 \times 2.5 \times .0043 \times 3.54 \times 10^7 \div 1.67$, or the area required is 96.400 square centimetres, or 10,759 square inches. In obtaining from this the number of plates of a given size, it is obviously necessary to remember that on the two outer plates only one surface is effective, so that one more plate is required than the formula would appear to give. It is stated that the capacity of a condenser of 65 plates made in this manner came out on testing by one method exactly correct, and tested in another way correct within two per cent. With reference to this absolute accuracy, it may be observed that in most tables of the values of k a very considerable margin is allowed in the figures.

Screw Propellers for Flying Machines.—Although we are not aware of actual progress having been made in the problem of flight since the days when Mr. Maxim exhibited, not exactly his flying, but his flying machine, the subject constantly crops up again in the technical press. The *Zeitschrift des Oesterreichischen Ingenieur und Architecten Vereins"* publishes a letter from Professor G. Wellner, of Brünn, who, like many others, is still in the preliminary stages of experiment, whilst Mr. Lilienthal and others know from experience that the bird-like motion is risky. Professor Wellner has been experimenting with large propellers, 20 feet in diameter, made of aluminium and balloon cloth, fixed on a firm stand, and driven by a semi-portable engine of two horse-power. With 150 revolutions per minute he realized a lifting power of 132 lbs., which is not sufficient for a robust man.—*The Trade Journal Review.*

THE CRESCENT SHADE.

Vallee Bros. & Co., of Philadelphia, Pa., are now putting on the market what is known as their "crescent" shade. This shade has been designed to meet all the requirements of the users of tin shades. It is made of heavy tin, and the corrugations and shape are so arranged as to give the greatest reflecting power. This shade is made in two



THE CRESCENT SHADE.

styles, viz.: enameled white inside, green outside and bright tin inside, imitation brass outside. The reflecting powers of this shade are unsurpassed by any tin shade now in use. A sample "crescent" shade is now doing duty in the office of The Electrical Age, where it gives the utmost satisfaction by reason of its great reflecting power.

The Standard Paint Company have moved to their new and elaborate offices, show and salesrooms, 81–83 John street, N.Y., from 2 Liberty street. They will occupy two floors at 81 John street, the main floor for general show rooms. Frank de Ronde, the general sales agent, will occupy a fine suite of offices in the rear, where he will have plenty of light and ventilation. The fans are all up for a hot summer siege; his choir of assistants will have rooms adjoining; a reception room has been provided for visitors.

The second floor is highly decorated and finished in gold; the front office will accommodate the president, Mr. Ralph L. Shainwald and his associates. The rear office will be presided over by Mr. F. F. Vandewater. Adjoining is a room set apart for Schiff, Jordan & Co, ship carbons, presided over by a competent salesman.

Point Pleasant, March 26, 1896.

The Partridge Carbon Co.,
Sandusky, O.

Gentlemen :—I send you today two motor brushes made by you and bought by us from Westinghouse Electrical and Manufacturing Co. during July, 1894. These two brushes have been in use for some seven (7) months, during which time the car has made a mileage of about 48,000 to about 50,000. The brushes sent are about the worst worn of a set of ten that I have in my possession.

To me this is something extraordinary, as I have had the experience of seeing new carbon brushes put on motors every other night.

We are using Westinghouse No. 12, 20 H. P. motors. I would say that I originally bought 100 brushes, and I have them all now, none having been used except the ten as above, which are good for another 50,000 miles run. I do not think there is another such brush on earth as the Partridge for long life, wear on commutator, etc. I believe in showing appreciation of a good thing; hence my letter.

Very truly yours,
South Jersey Street Railway Co.
Per P. T.

N. B.—Would say that our line runs along beach front, where sand and dust are in plenty.

The New York correspondent of the Electrical Age was astonished one day last week to see a big *reel* of cable in front of the works of the Safety Insulated Wire and Cable Co.'s Works, 225 to 229 West 28th street, New York. The big *reel* stood almost to the second story window of the office on the second floor of 229 West 28th street. This reel of cable is the second one of an order of three submarine cables for the Metropolitan Telephone Co. of New York, to connect them with New Jersey and the West. Mr. L. R. Clark, the electrical engineer in charge of testing-room of the Safety Insulated Wire and Cable Co., furnished us with the following information :

Order taken by H. T. Richards.

New York, April 4, 1896.

The "Electrical Age,"
World Building, New York.

The particulars regarding the large reel of cable examined by your representative are as follows :

The dimensions of the reel of cable are nine feet in diameter and ten feet long.

The cable is 5,000 feet long, composed of 20 conductors, each composed of three No. 22 B. W. G. copper wires, insulated to 8/32 of an inch with Safety submarine compound, and taped.

The conductors are twisted in pairs, then laid up helically, the whole cable then taped and served with two layers of tarred jute ; then armored with 25 No. 4 B. W. G. galvanized iron wires. The armor is covered with two layers of jute, treated with mineral pitch and tar.

The insulation resistance per mile of this cable is 1,600 megohms, at 60 degrees Fahr., and about 6,000 megohms per mile when laid, and at the temperature of the river bottom.

The weight of the finished cable and reel is nearly twenty tons.

This is the second of a series of three similar cables now being made for the Metropolitan Telephone and Telegraph Company of New York, and is to be laid from New York to Jersey City.

WILL OUR HOMES BE LIT BY ACETYLENE GAS.

In 1883 London and its suburbs were supplied with light by 18 public gas-works. The amount of capital invested exceeded 15 million dollars. Fourteen years later one-half a million tons of coal were used yearly, and the gas mains exceeded 2,000 miles in length.

Simply as a means of considering the enormous capital thus spent the dust has been shaken from forgotten volumes and this ancient history again reviewed. Today the gas consumption is many times greater, the money invested would form a mountain of gold and the system employed, with its strict economy and perfection in every detail, bids fair to stand uninjured, the opposition and onslaughts of rival companies —the installation of electric light plants as well as the acetylene equipments so loudly applauded.

The factors of progress shine forth in this brief resumé and it seems that the least important is not gas. What the wide-spread use of electricity will do in the future it is difficult to say, but its intimacy with the household will depend in days to come upon its cheapness for heating and kitchen use. In this respect gas rules, and the economy and excellence of modern gas stoves brings it beyond compare.

Acetylene gas with its presumptuous attitude and predicted introduction as a general illuminant needs consideration.

The Progressive Age had determined to investigate the so called cheapness of acetylene and to discover whether the disputed and confusing reports of its cost (which varies from five dollars to twenty-three dollars per ton of product) can be consistently quoted. Prof. Edwin J. Houston and Dr. Kennelly have been chosen for this purpose, and the results of their criticism will shed light upon a subject at present so frequently debated. The beauty of acetylene has never been doubted as a source of brilliant light. But its dangers and risks need more than a passing consideration.

Baltimore, Md.—The Baltimore & Ohio Railroad Co. contemplates the extension of its electric system and making use of the surplus power of Link Belt Tunnel Co. for lighting, power, etc.

The number of exhibitors at the Electrical Exhibition has been steadily on the increase. We publish below a list of the firms whose activity in this direction has been the means of spreading enthusiasm and guaranteeing *a priori* its unqualified success. The West was and has been until recently considered the seat of electrical enterprise, but that idea is fast being changed; Chicago has had its day, and the great exhibit with its new and interesting features will localize once more in its proper place as the true centre of electrical industries and successful enterprise. We are all of one opinion as to the result, and all supplied with the proper energy, vigor, influence and zeal to make this exhibit a crown to the East, a concentration of allied manufactures, a focus of able men and new things.

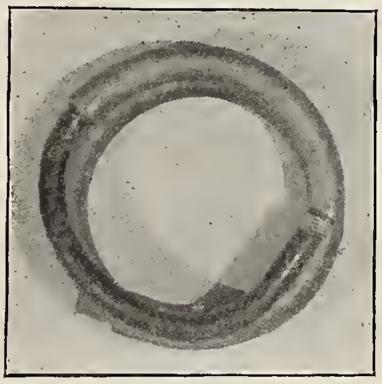
REVISED LIST OF EXHIBITORS UP TO AND INCLUDING APRIL 3.

Abendroth & Root, Manufacturing Co., New York.
Adams-Bagnall Electric Co., Cleveland, O.
American Carbon Co., Noblesville, Ind.
American Electric Heater Corporation, Boston, Mass.
American Stoker Co., Dayton, O.
Anchor Electric Co., Boston, Mass.
Babcock & Wilcox Co., New York.
Ball & Wood Co., New York.

Bishop Gutta-Percha Co., New York.
Birdsall Electric Manufacturing Co., New York.
Bryant Electric Co., Bridgeport, Conn.
Brady, T. H., New Britain, Conn.
Bradford Belting Co., Cincinnati, O.
Bryan-Marsh Co., New York.
Bossert, Wm. F., Utica, N. Y.
Bourne, Scrymser & Co., New York.
Burry John, New York.
Case, J. T., Engine Co., New Britain, Conn.
Card Electric Motor and Dynamo Co., Cincinnati, O.
Carpenter Enamel Rheostat Co., Hoboken, N. J.
Calculagraph Co., New York.
Clark Electric Co., New York.
Columbia Incandescent Lamp Co., St. Louis, Mo.
Corey, R. B., New York.
Chapin-Douglass Electric Co., New York.
Cutter Electrical Mfg. Co., Philadelphia, Pa.
Crocker-Wheeler Electric Co., New York.
Columbia Rubber Works Co., New York,
Crouse-Tremaine Carbon Co., Fostoria, O.
Crane Co., New York and Chicago.
Dale, Farrell & Co., New York.
Diehl & Co., Elizabethport, N. J.
DeVeau & Co., New York.
Eddy Electric Mfg. Co., Windsor, Conn.
Edison Electric Illuminating Co., New York.
Electrical Engineer, New York.
Electricity Newspaper Co., New York.
Electric Storage Battery Co., Philadelphia, Pa.
Electrozone Co., New York.
Forest City Electric Co., Cleveland, O.
Fort Wayne Electric Corporation, Fort Wayne, Ind.
Ferracute Machine Co., Bridgeton, N. J.
Fuel Economizer Co., Matteawan, N. Y.
Goubert Manufacturing Co., The, New York.
General Electric Co., Schenectady, N. Y.
Gordon Burnham Battery Co., New York.
General Incandescent Arc Lamp Co., New York.
Harrisburg Foundry and Machine Co., Harrisburg, Pa.
Huebel & Manger, Brooklyn, N. Y.
Holtzer-Cabot Electric Co., Boston, Mass.
Heine Safety Boiler Co., St. Louis, Mo.
Hunt, C. W., Co., New York.
Iron-Clad Rheostat Co., Westfield, N. J.
India-Rubber and Gutta-Percha Insulating Co , Yonkers, N.Y.
Interior Conduit and Insulation Co., New York.
Jewel Belting Co., Hartford, Conn.
Johnston, The W. J., Co., New York.
Keasbey, R. A., New York.
Kennedy Valve Manufacturing Co., New York.
Keuffel & Esser Co., New York.
Katzenstein, L., New York.
Losier, R. T., New York.
Locke Regulator Co., Salem, Mass.
Mica Insulator Co., New York.
McCreary, A. A., New York.
McEwen, J. H., Manufacturing Co., Ridgeway, Pa.
Metropolitan Telephone and Telegraph Co., New York.
National Carbon Co., Cleveland, O.
National Conduit Manufacturing Co., New York.
Niles Tool Works Co., Hamilton, O.
Nowotney Electric Co., Cincinnati, O.
Nuttall, R. D., Co., Allegheny, Pa.
New York and Ohio Co., Warren, O.
New York Safety Steam Power Co., New York.
Okonite Co., New York.
Phœnix Iron Work, Meadville, Pa.
Peck Electrical Co., New York.
Partrick & Carter Co., Philadelphia. Pa.
Peru Electric Manufacturing Co., Peru, Ind.
Payne, B. W., & Sons, Elmira, N. Y.
Proctor-Raymond Co., Buffalo, N. Y.
Reisinger, Hugo, New York.
Riker Electric Motor Co., Brooklyn, N. Y.
Roebling's Sons' Co., John A., New York.
Russell & See, New York.
Safety Insulated Wire & Cable Co., New York.
Schieren, Chas. A. & Co., New York.
Schiff, Jordan & Co., Vienna, Austria.
Schoonmaker, A. V., New York.
Searles, A. M., Chicago.
Schultz Belting Co., St. Louis, Mo.
Siemens & Halske Co., of America, Chicago, Ill.
Smeltzer & Co., Nurnberg, Bavaria.
Spon & Chamberlain, New York.
Standard Electric Lamp & Novelty Co., New York.
Standard Paint Co., New York.
Standard Underground Cable Co., Pittsburgh, Pa.
Stanley Electrical Mfg. Co., Pittsfield, Mass.
Stanley & Patterson, New York.
Stirling Co., The, Chicago, Ill.
Straight Line Engine Co., Syracuse, N. Y.
Sunbeam Incandescent Lamp Co., Chicago, Ill.
Syracuse Storage Battery Co., Syracuse, N. Y.
Tellmic Manufacturing Co., New York.
Thomson Meter Co., Brooklyn, N. Y.
Tucker Electrical Construction Co., New York.
United Electric Improvement Co., Philadelphia, Pa.
United States Mineral Wool Company, New York.
Vacuum Oil Co., New York.
Vetter, J. C. & Co., New York.
Walker Company, Cleveland, O.
Warren, A. K. & Co., New York.
Warren Electric Co., Cnicago.
Watertown Engine Co., Watertown, N. Y.
Wagner Electrical Mfg. Co., St. Louis, Mo.
Wendell & McDuffie, New York.
Weston Engine Co., Painted Post, N. Y.
Weston Electrical Instrument Co., Newark N. J.
Williamsport Wooden Pipe Co., Williamsport, Pa.
Worthington, Henry R., New York.
Wilkinson Manufacturing Co., Bridgeport, Conn.

RUNNING NIGHT AND DAY.

UNDERGROUND CABLES IN TOLEDO AND THE NATIONAL UNDERGROUND CABLE CO.



IN LOOKING over our reports we see that the National Underground Cable Company has just been awarded a contract by the Toledo Traction Company, Toledo, Ohio, for all the underground cables to be used by the latter company dur ing the year 1896.

This contract for underground cables is one of the largest ever given out in the United States, and covers cables for several kinds of service, including railway feeder, electric light and power distribution, and when finished will be the only system in the world in which series arc circuits and the three-wire system will be distributed from the same station. The distribution will be done from one immense central station, and the sizes of cables to be used run from No. 6 B. & S. G. to over 1,000,000 circular mils.

The contract of the National Company covers also all the work of laying and joining and connecting of the cables and the furnishing of all apparatus to be used in connection with the underground system.

The National Conduit Manufacturing Company, the associate company of the National Underground Cable Company, furnished all the underground conduits and built the complete subway system for the Toledo Traction Company—so that we have, in this case, a demonstration of the practicability and advisability of having one large and reliable concern do all the work of building the underground subways and furnishing and installing the cables therein, or in other words, of having one large contractor responsible for all the work.

As a result of its continuously increasing business, the National Company's cable factories at Harrison, N. J., and conduit factories at Hastings-on-Hudson, N. Y., are compelled to run night and day to keep up with orders.

Trade Notes.

The Cutter Electrical and Manufacturing Company, 1112 Sansom street, Philadelphia, announce that they have in their printer's hands a beautifully illustrated catalogue of their C-S flush switches and accessories. This promises to be the most elaborate catalogue devoted to this subject, and will be sent post-paid to all interested.

They are also preparing an illustrated catalogue of the I-T-E circuit breaker, about which we are hearing favorable comments on all sides. This will be ready early in May.

Woodstock, N. B.—Application is being made to the local legislature by J T. Allan Dibblee, Juliens T. Garden and J. N. W. Winslow for incorporation of the Woodstock Electric Railway, Light and Power Company. The object of the company is to generate electricity for the purpose of supplying power and light.

Possible Contracts.

Brooklyn, N. Y.—Plans are now being perfected for the erection of a mammoth storehouse by the American Sugar Refining Co in Kent avenue, between North Ninth and North Tenth streets, and running back to Wythe avenue. The structure will be ten stories in height.

New York City.—The Teachers' College, 15 University place, has received a gift of $250,000, and the trustees will now make an addition on the west side of the main college building.

Philadelphia, Pa.—The project for a new railroad line across the State about midway between the Pennsylvania and the Philadelphia and Erie is again being revived. It is stated that a meeting will be held to organize a construction company, and that early in April work will be begun on two portions of the line, from Phillipsburg to Bellefonte and from Lamar to Clinton County, to Watsontown, on the Susquehanna River.

Manchester, N. H.—Ground will be broken for the proposed $500,000 passenger station of the Boston & Maine at Manchester, May 1. Besides this new station a mammoth freight house is to be built. It will be 760 feet long and 50 feet wide.

Hartford, Conn.—The Phœnix Mutual Life Insurance Co. propose to erect a handsome block on Pearl street, on the old Tertius Wadsworth homestead.

Philadelphia, Pa.—A mammoth office building, sixteen stories in height, is to be erected on the site of the Girard House.

Hamilton, O.—At the meeting of the council, March 17, the city clerk was authorized to advertise for bids for a police telegraph service.

New York City.—Darius O. Mills will erect a ten-story and basement brick hotel at Bleecker, Sullivan and Thompson streets, at a cost of $700,000. Address of Darius O. Mills, 634 Fifth avenue.

Detroit, Mich. — The directors of the Fort Wayne & Belle Isle Railway Co. increased the capital stock from $300,000 to $400,000 The additional $100,000 will be used in rebuilding the road on the east end of Monroe avenue, River street and on Fort street west of Clark avenue.

New York City.—James L. Lloyd, S. Carroll Bryce and Clement Fish will erect a fourteen-story brick store and lofts at 656 Broadway, at a cost of $187,500.

Chicago, Ill.—Sealed proposals will be received by the City of Chicago, until April 8, for the construction and installation of the compressed air, and electrical equipment for the new rolling bascule bridge over the north branch of the Chicago River at North Halsted street, according to plans and specifications on file in the office of the Department of Public Works. W. D. Kent, Commissioner of Public Works.

Arverne, L. I., N. Y.—Sealed proposals for furnishing, lighting, cleaning and maintaining 80 or more street lamps (or their equivalent in actual street illuminating power in arc electric lights) in the village of Arverne-by-the-Sea, are invited. Bidders must state the price for each lamp, for lighting upon the New York City schedule every night and all night; also for lighting 26 nights in each month all night for a contract for one year; also for three years and for five years. The price to include the furnishing of first-class posts, lanterns, etc. Each lamp to be of not less than 20 candle-power if gas, and not less than 1,200 candle-power if electric light. The contract to take effect June 1. Proposals are to be addressed to John R. Waters, president, Arverne-by-the-Sea, Long Island, N. Y., and indorsed "Proposals for Lighting," and will be received at the office of A. E. Karelson, Village Clerk, until 4 p. m, April 4.

Telephone Notes.

Bristol, Vt.—South Bristol is soon to be connected with the village by telephone.

California, Pa.—The town will now soon be wired for telephones.

New Baltimore, Pa.—The Somerset, Bedford and New Baltimore Telephone Co., at a recent meeting at New Baltimore, decided on a route for their line, which will be surveyed as soon as the weather will permit. The line will be from New Baltimore to Shanksville and thence to Somerset, by the shortest line.

Boscobel, Wis. — L. D. Holford of the Grant County Telephone Co. is in the city. His object is to place an exchange system here to connect with Lancaster, Bloomington and other points of the city and county.

Marysville, Tenn.—The Marysville Telephone Exchange is to be enlarged.

Parkston, S. D.—The Aberdeen Telephone Company is contemplating extending its lines to several outside towns.

Lacook, N. H.—A local telephone service is shortly to be inaugurated.

Greensboro, N. C.—Arrangements have been completed by T. J. McAdoo, of Greensboro; R. J. Oliver, of Reidsville, N. C., and W. G. Mebane, of Burlington, N. C., for the connection of seven North Carolina towns by telephone.

(*For Telephone Patents see page* 183.)

FOR UPTOWN TELEPHONE SUBSCRIBERS.

An uptown branch of the Contract Department of the Metropolitan Telephone and Telegraph Company has been established at 113 West 38th street (one door from Broadway), where all business relating to the supply of telephone service can be transacted as readily as at the main office at 18 Cortlandt street. There are 14,500 telephone stations in New York City. Metallic Circuit Service, Rapid, Efficient, Permanent, can be had from $75 a year.

NEW TELEPHONE COMPANIES.

Oxford, Pa.—The Octoraro Telephone & Telegraph Co. is one of the latest enterprises here and is composed of prominent business men of Oxford and lower Lancaster County. It is capitalized at $5,000 and operates under the provisions of a State charter. The main line extends along the Lancaster, Oxford and Southern Railroad to Peach Bottom, a distance of 20 miles.

New Corporations.

Burlington, Ia.—Walsh Bros. of this city, owners of the electrical street railway gas and electric lighting companies, steam supply company and other enterprises, have announced a new deal to purchase the Davenport Electric Light Co. with J. C. Hubbinger, of Keokuk, as partner. Also to invest $50,000 in street railway extensions. The entire deals as announced for the two cities will amount to $50,000,000, to be expended in six months.

Albany, N. Y.—The Kings County Traction Co. was incorporated to carry on a street and other railway construction business, with principal office, New York City. Capital, $6,000. Directors, P. F. Vaughan, and J. F. Lockman of Brooklyn, and Emil Carlebach, J. A. Snyder and George H. Levy of New York City.

New York City.—Electric Scenic Co. Capital, $20,000. Directors, George W. Bitthridge, W. S. Munn, P. Smith and others of New York City.

Chicago, Ill.—Rieth Electric Co. Capital, $4,000. Incorporators, Robert D. Rowe, Peter Rieth and John M. McNabb.

Rahway, N. J.—The Standard Railway Signal Co. filed articles of incorporation. Capital, $300,000. The company will manufacture interlocking block signal systems of all kinds for railways. Incorporators, William B. Wells, John M. Randolph, all of Rahway.

St. Louis, Mo—Universal Light & Power Co. Capital, $24,000. Incorporators, M. Niebling and A. F. Beasley.

Cadiz, Ky.—The Cadiz Railroad Co. has been organized. Incorporators, W. C. White, Dr. J. W. Crenshaw, B. F. Goodwin, G. F. G. Terry, D. L. Grinter and M. S. Thompson.

CANADIAN LETTER.

BY OUR MONTREAL CORRESPONDENT.

Electric Railways.

New Westminster, B. C.—If the city council of New Westminster, B. C., will grant a bonus of $50,000, the Consolidated Railway and Light Company will build an electric railway from Westminster to Steveston, wih a branch to Sapperton, and locate the central offices and repair shops in New Westminster.

Grimsby, Ont.—The Hamilton, Grimsby and Beamsville Railway directors have employed R. H. Fraser, of Toronto, to survey a private route from Grimsby to Grimsby Park, to avoid going along the road, owing to the high terms asked for the privilege by the Grimsby council. The right of way will be purchased.

Hamilton, Ont.—The new board of directors of the Hamilton Radial Railway Company is as follows: Rev. Dr. Burns, president; A. McKay, M. P., vice-president; J. D. Andrews, secretary; W. G. Lumsden, treasurer; James Masson, M. P., Owen Sound; F. A. Carpenter, A. H. McKeown, E. P. Powell, London, Ont.; J. F. Smith, Thomas Ramsay and R. McKay.

Hamilton, Ont.—The H. G. & B. Electric Railway Company has an agreement with the H. & D. Railway Company by which it has permission to use the tracks of the latter on Main street until June 30. It has asked to have this permission extended, but the H. & D. Railway Company has refused the request and the intervention of the Hamilton City Council is sought by the H., G. & B.

Ottawa, Ont.—The Ottawa *Journal* says: "The Ottawa and Aylmer Railway and Bridge Company, Limited, composed of the leading shareholders of the Ottawa Electric Street Railway Co., will begin the building of an electric railway to Britannia by the tenth of April, and anticipate having the line completed six months later. The line will run along the south side of the Richmond road, at a distance of twenty feet from the roadway."

Montreal, Que.—The promoters of the Canadian Electric Railway and Power Company, which proposes to build an electric line from Windsor to Montreal, are Castle Smith, London, Eng.; J. K. Osborne, F. M. Jones, C. W. Beardmore, W. H. Cawthra and Edmond Brittol, of Toronto, and E. F. Fauquier, of Ottawa. The application was opposed by the Grand Trunk and C. P. R. authorities before the railway committee and will receive further consideration.

J. Alcide Chaussé.

New York Notes.

The Manufacturers' Advertising Bureau, Benj. R. Western, proprietor, which has been located for a number of years at 111 Liberty street, New York City, will remove about April 15 to more commodious quarters at 126 Liberty street.

This concern is widely and favorably known throughout both this country and abroad, and is unique in the business it transacts, which is unlike any other in the world and consists in taking entire charge of the newspaper work and advertising for manufacturers who desire this very important department of their business conducted with the greatest convenience and profit. The bureau handles almost exclusively concerns who advertise in the trade journals, Mr. Western being a recognized expert in advertising media of this character, and has established a reputation for commercial integrity and scrupulous attention to the interests of its clients, of which it may well feel proud. A large number of the leading machinery concerns in this country now entrust their advertising to the care of this institution.

It is because of a growing need for better facilities to transact its business that the change from 111 to 126 will be made. The Manufacturers' Advertising Bureau is credited with being the largest user of advertising space in the trade journals in the United States.

The Dickinson Electrical Supply Co., American Tract Society Bldg., N. Y., are moving to 141 Broadway, where they will have more commodious salesrooms and offices. They make the popular Alpha sign lamps, and a specialty of incandescent lamps.

The National Electric Light Association hold their 19th convention Monday, May 5, Tuesday, May 6, and Wednesday, May 8, at the Grand Central Palace Lexington avenue and 43d street, New York city.

ELECTRICAL and STREET RAILWAY PATENTS

Issued March 30, 1896.

TELEPHONE PATENTS ISSUED MARCH 30, 1896.

557,153. Apparatus for Telephone-Lines. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed Aug. 17, 1895.

557,154. Apparatus for Telephone-Lines. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed Aug. 17, 1895.

557,284. Telephone Switch and Support. Edward C. Paramore, Philadelphia, Pa. Filed Apr. 24, 1895.

557,527. Switchboard-Signal. Isaiah H. Farnham, Wellesley, Mass., assignor to the American Bell Telephone Company, Boston, Mass. Filed Jan. 16, 1896.

557,497. Electric Gate-Operating Mechanism. Francis J. Dyett, Ilion, N. Y. Filed Nov. 1, 1893.

557,518. Carbon-Holder for Arc Lamps. Chas. A. Pfluger, Chicago, Ill. Filed Aug. 7, 1895.

557,099. Multiple-Series System of Electrical Distribution. Francis B. Badt, Chicago, Ill., assignor to the Siemens &

Halske Electric Company of America, same place. Filed Sept. 25, 1895.

557,114. Trolley-Pole Support. Nathan H. Davis, Philadelphia, Pa. Filed Nov. 8, 1895.

557,121. Magnetic Ore-Separator. Oriel M. Graves, North Yakima, Wash. Filed June 17, 1895.

557,139. Rail-Bond and Electrical Connector. Chas. E. Moore, Chicago, Ill., assignor to Menard K. Bowen, same place. Filed Oct. 9, 1895.

557,145. Car-Fender. Peter McMenamin, Jersey City, N. J. Filed Apr. 26, 1895.

557,159. Electrical Dental Plugger. Perry R. Skinner, Oneonta, N. Y., assignor of one-half to Arthur S. Barnes, same place. Filed May 6, 1895.

557,161. Street-Car Fender. Willard Spencer, Bath, N.Y., assignor of one-half to James A. Houck, Albany, N. Y. Filed Aug. 16, 1895.

557,164. Electric Meter. Charles P. Steinmetz, Schenectady, N. Y., assignor to the General Electric Company, of New York. Filed Jan. 15, 1896.

557,174. Rail-Bond or Connection. Edward A. Turner, Chicago, Ill. Filed Sept. 7, 1895.

557,185. Regulating Electric Motors. James Burke, Newark, N. J., assignor to the General Electric Company, of New York. Filed Sept. 4, 1895.

557,198. Snap-Switch. Jacob S. Gibbs, Hartford, Conn. Filed Jan. 20, 1896.

557,201. Car-Fender. Theodore C. Hammond, Newark, N. J. Filed Oct. 3, 1894.

557,206. Car-Fender. Paul Jones, Cincinnati, Ohio. Filed Dec. 20, 1895.

557,218. Commutator for High-Voltage Dynamos. August J. Oehring and Henry H. Wait, Chicago, Ill., assignors to the Western Electric Company, same place. Filed Aug. 20, 1895.

557,224. Electric Switch. Charles G. Perkins, Hartford, Conn., assignor to The Perkins Electric Switch Manufacturing Company, same place. Filed Jan. 2, 1894.

557,226. Car-Fender. Simon A. Politsky, Boston, Mass. Filed Aug. 2, 1895.

557,229. Electric-Arc Lamp. William D. Ray, Chicago, Ill. Filed July 11, 1894.

557,257. Electric Cut-Out. Robert G. Davis, Brooklyn, N. Y., and Albert M. Torrance, Bennington, Vt.; said Davis assignor to said Torrance. Filed July 5, 1893.

557,258. Electric Railway. Patrick B. Delany, South Orange, N. J. Filed Oct. 10, 1892.

557,262. Car-Fender. John P. Geraghty, Jersey City, N. J. Filed June 11, 1895.

557,282. Electric Car-Heater. Joseph G. Noyes, Milford, Conn. Filed Aug. 16, 1895.

557,316. Car-Fender. Franz Padberg and Carl Hummel, New York, N. Y. Filed July 18, 1895.

557,324. Art of Electric Dyeing. George D. Burton, Boston, Mass., assignor to John J. Moore, Springfield, Mass., and James McCabe and Walter A. Byrne, Auburn, N. Y. Filed Sept. 25, 1895.

557,325. Art of and Apparatus for Electro-dyeing. George D. Burton, Boston, Mass, assignor to John J. Moore, Springfield, Mass., and James S. McCabe and Walter A. Byrne, Auburn, N. Y. Filed Oct. 31, 1894.

557,326. Art of an Apparatus for Electric Dyeing and Shrinking. Geo. D. Burton, Boston, Mass., assignor to John J. Moore, Springfield, Mass., and James S. McCabe and Walter A. Byrne, Auburn, N. Y. Filed Feb. 25, 1895.

557,334. Safety-Fender for Cars. George H. Moller, New York, N. Y., assignor to Harold G. Moller, same place. Filed Aug. 7, 1895.

557,336. Street-Car Fender. James H. MacDonald, New Haven, Conn. Filed July 22, 1895.

557,342. Shade for Incandescent Electric Lamps. Solon O. Richardson, Jr., Toledo, Ohio. Filed Nov. 1, 1892.

557,355. Galvanic Battery. Edward S. Boynton, Brooklyn, N. Y. Filed Feb. 21, 1895.

557,356. Galvanic Battery. Edward S. Boynton, Brooklyn, N. Y. Filed Sept. 13, 1895.

557,375. Cigar-Lighter. James Frye, Philadelphia, Pa. Filed July 16, 1895.

557,384. Fan-Motor. Robert H. Hassler, Dayton, Ohio. Filed Nov. 27, 1895.

557,386. Rheostat. Harry E Heath, Windsor, Conn., assignor to the Eddy Electric Manufacturing Company, same place. Filed Dec. 26, 1895.

557,398. Distribution of Electric Currents. Isidor Kitsee, Philadelphia, Pa. Filed Sept. 16, 1895.

557,403. Electric Flash-Light Apparatus. George R. Lawrence, Chicago, Ill. Filed May 17, 1895.

557,422. Means for Transmitting Electrical Energy. Thomas W. Onderdonk, New York, N. Y. Filed Apr. 9, 1895.

557,434. Electrical Lighting Apparatus. Ralph A. Schoenberg, John W. Flucker, and Alfred N. Keedwell, New York, N. Y. Filed Dec. 5, 1895.

557,442. Trolley for Electric Railways. Henry A. Seymour, Washington, D. C. Filed Feb. 1, 1896.

The Electrical Age.

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RADIOGRAPHY.

The novelty of X ray work is slowly passing away. The countless experiments made with but one object—a photograph through an opaque substance or the representation of a more grisly part of our own anatomy will, in the future, be classified and arranged as a practical department of electro-optics. It seems that a conflict of opinions has arisen as to the determination of an X ray in an exact sense. The present discussions regarding their nature still leave the matter in doubt, and the ultimate issue is as far from being satisfactorily settled as before. There is no disagreement about results from a general standpoint. But upon investigation the adversity of opinions seems to be based upon :

(I) The nature of the phemonena ; whether a condition of the ether that depends upon such peculiar circumstances as exist, particularly in a Crookes tube.

(II) Whether the so-called Roentgen effect is due to the existence of a powerful propulsive force acting upon the remaining molecules in the exhausted tube, forcing them forward in straight lines or streams, such as longitudinal waves might take, and thereby tending to identify such effects with the more tenuous ether waves.

(III) Whether the radiation due to either these purely molecular forces or longitudinal ether waves *can be reflected*.

It would require a course of careful laboratory work to properly inquire into the phenomena presented and attempt to correctly solve such problems.

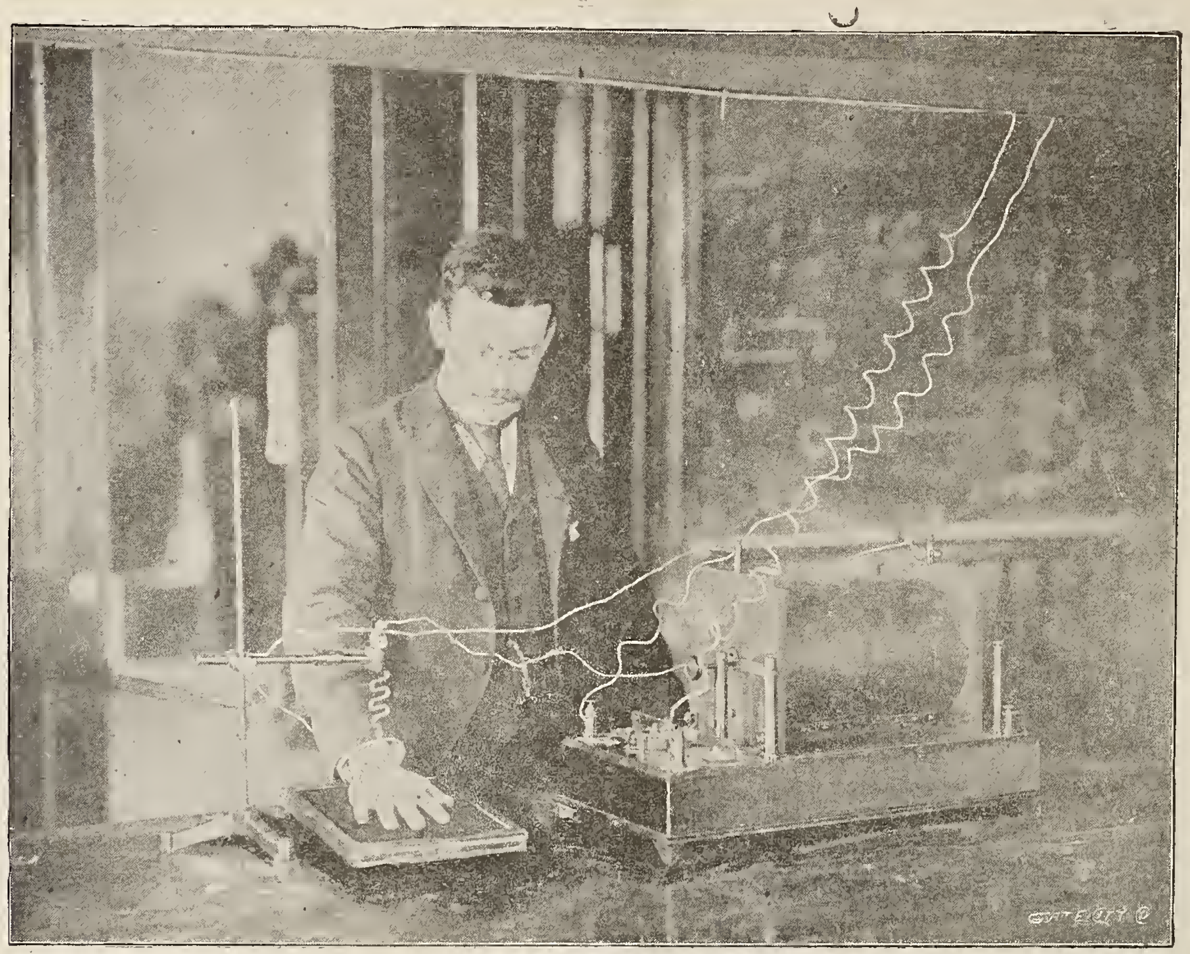
Other phases of this subject have presented themselves, which are as indicative of an unfamiliar condition, of a totally strange and unprecedented property, as the peculiar penetrative power of the rays so often dilated upon.

In *Science* of April 10, '96, Wm. Lispenard Robb, of Trinity College, carefully examines into the effect spoken of by Prof. J. J. Thompson, regarding "*the power of Roentgen rays to dissipate the charge of an electrified body.*" He also speaks of *the reduction in insulation resistance* of a condenser when exposed to these remarkable waves. This fact is deeply interesting, as we find a parallel to it in the effect of ordinary light waves upon the metal selenium, its resistance under similar conditions being likewise decreased.

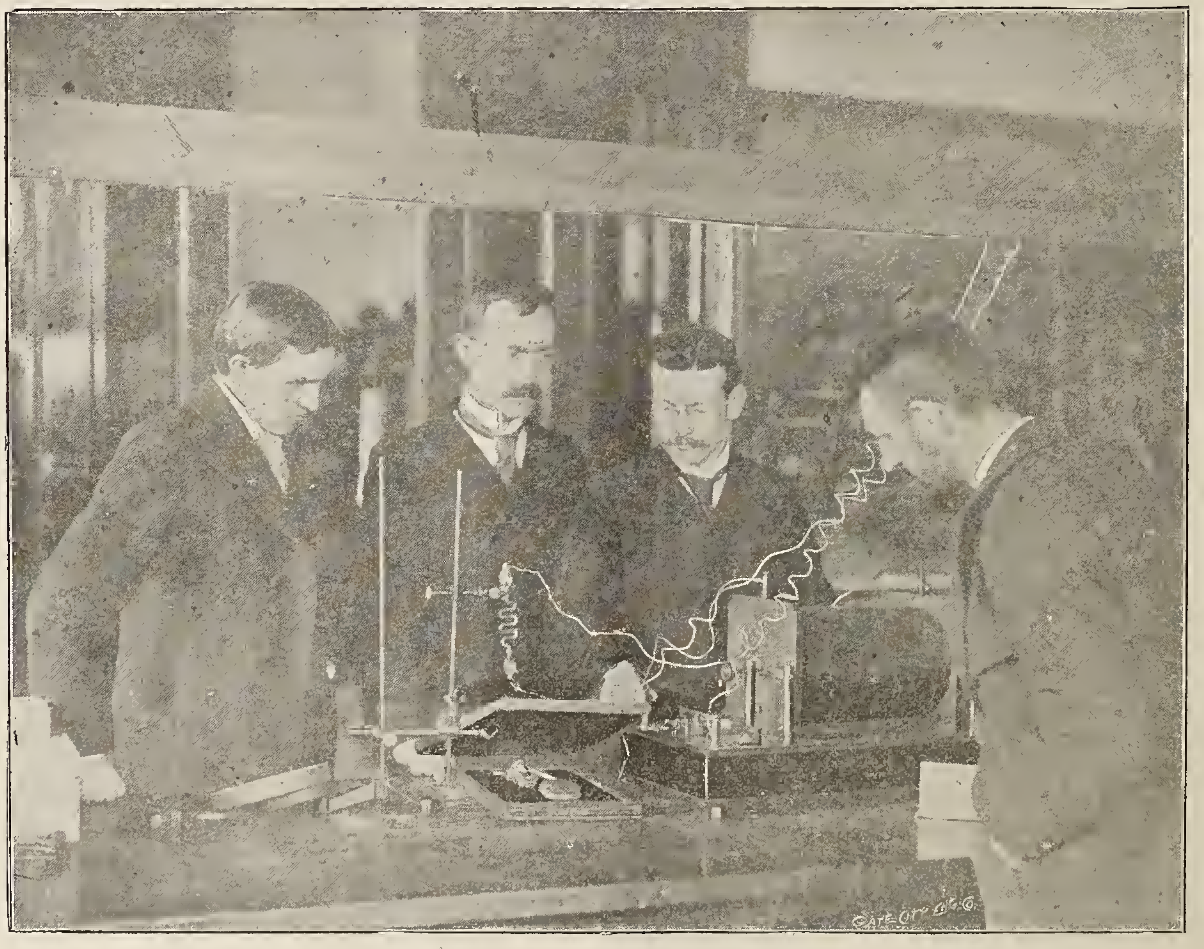
This phenomenon cannot be caused by the passage of material particles, but seems to be due to an impressed force acting upon the normal molecular arrangement in such a manner as to distort or twist the molecules, or directly affect the ether atmosphere surrounding them and thus improve the conductivity of the body. This phenomenon under any circumstances might have more bearing upon the nature and character of Roentgen rays, if properly investigated, than any other.

Yet aside from such allusions the nature of the phenomenon should not be considered from the standpoint of molecular impact such as Tesla so strongly advocates. A magnetic needle may be equally affected by a transient magnetic change or the vibration of its support. Numerous other instances might be adduced to illustrate the coincidental action of two dissimilar forces productive of the same effect *per se*, but absolutely foreign in their relation and bearing upon the phenomenon itself. A stream of material particles certainly has much in favor of its adoption as the cause of X ray effects, but while seemingly competent to perform many of the known functions of that species of light, a more careful examination will probably show that it is simply an auxiliary that has thus far been mistaken and identified with the more important and less obtrusive Roentgen ray.

Prof. Michael I. Pupin of Columbia Colllege has been an earnest and conscientious worker in this absorbing line of research, and in a paper delivered before the New York Academy of Sciences, April 6, 1896, entitled: "Diffusive Reflection of Roentgen Rays," he refutes several points hitherto advanced by an eminent authority. It seems that an intimate knowledge of the phenomena of light is absolutely essential before any inference can be drawn from the numberless experiments heaped up for public view. The



AN EXPERIMENTER PHOTOGRAPHING HIS HAND.
(By kind permission of *Looking Glass* and courtesy of *Current Literature.*)



PHOTOGRAPHING OBJECTS THROUGH A PIECE OF WOOD.
(By kind permission of *Looking Glass* and courtesy of *Current Literature.*)

Roentgen ray must be first defined before its effects can be appreciated. At present the doubts as to its identity are bewildering in the extreme and have left the matter in many respects more closely veiled than ever. There have been attempts made to reflect the rays; yet it is impossible to confidently assert that such has been done. A remarkable fact, illustrated by the most careful experiments of Prof. Pupin, may be stated in his own words: "These experiments prove beyond all reasonable doubt that the Roentgen radiance is diffusely scattered through bodies, gases not excepted." Also a still more interesting statement that appeals to the reflective mind: "It might turn out, for instance, that the X rays are due to a circulating motion of ether, and that the stream lines are deflected and diffusely scattered within the molecular interstices of ponderable substances. Appearances seem to speak more in favor of this view than in favor of a wave motion of the ether."

Other results showing the evidence of careful observation and a most unbiassed survey of the circumstances are contained in these additional extracts:

"The diffuse scattering of the Roentgen radiance by bodies placed in its path may be also described by saying that *every substance when subjected to the action of X rays becomes a radiator of these rays.*

"The fact that opaque bodies like metals are less effective in producing this secondary radiation leads to the conclusion that there is in these bodies an internal dissipation of the Roentgen radiance much greater than in the case of transparent dielectric substances."

"The difference in their behaviour towards magnetic force is still to be explained. Is it not possible that this magnetic effect in air is masked by the diffuse scattering of the X rays?"

The mature suggestions made in the close of this article will by their bearing upon the mysterious ray produce the ripest fruits in the future for their able originator.

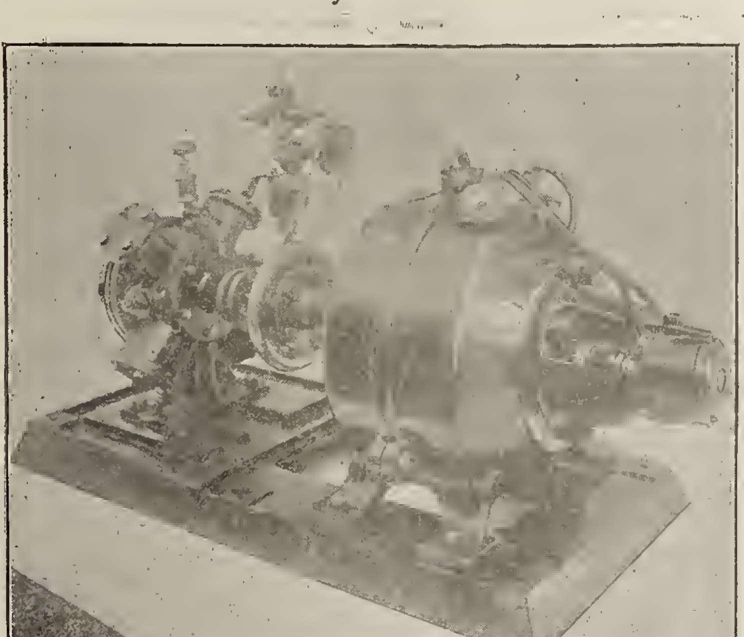
PRINCIPLES OF DYNAMO DESIGN.

BY

Newton Harrison E.E.

(*Continued from page* 174.)

A type of machine may be best selected with a certain fixed object in view and whether the controlling factor be lack of room, slow speed, or an enforced economy, let one be accepted that does not satisfy first the requirements of a good mechanical device, and then the regulation and perfection of a modern dynamo.



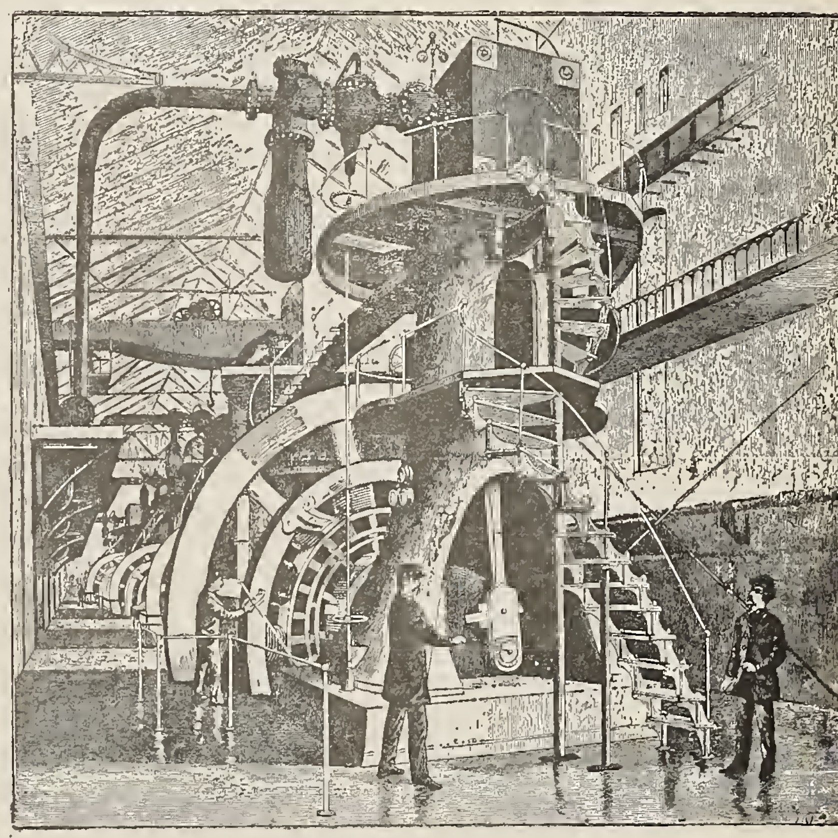
SMALL DIRECT-CONNECTED PLANT.

Dynamos are chosen at times with a total disregard for the convenience of the engineer, and show either a complete ignorance on the part of the proprietor in such matters pertaining to his own comfort, or a choice that is merely the result of fancy or the passing recommendation of a friend. A high foundation is sometimes built to supply the deficiency spoken of—namely a very low placed commutator. This in itself does not in any sense condemn the machine, but introduces a factor which is added as an antidote for a possible evil.

The vast number of designs exhibited by various manufacturers does not require more than a glance to show that the most preferable is one in which the brushes and commutator are immediately accessible, the natural height of the machine placing them in a handy position.

The limits of space must be carefully considered, because an excellent plant may be ruined by an attempt to connect it by belt, where the only sensible thing to do is to *couple direct.* Many shipboard plants were the source of considerable trouble, due to the fact that the rotation of the armature caused a gyroscopic tendency which might have been avoided either by changing the position of the dynamo with respect to the keel, of a belt-running plant, or by direct connecting.

Aside from those slight references, the lack of space is a means of judging at once as to the character of the plant to be installed, and still more the amount of electrical energy to be generated.



LARGE DIRECT-CONNECTED PLANT.

It is a common custom at present to connect large units at once to the engine or source of power. The saving in this respect is mainly one of power, which would otherwise be lost by a belting system. Above a certain size the advantages are certainly in favor of direct-connected plants, aside from the consideration of space. Yet it is well to choose on the basis of these two facts, and reasonably judge of the most correct practice. In central stations the use of triple-expansion engines is becoming common.

The practice originated in Europe and has proved to be successful beyond expectation.

Many methods of transmitting power by direct connection at present exist. An insulating device between the dynamo and engine is usually employed; the coupler being either two flanged pieces of face-plate pattern or a universal coupler, which will adjust itself to the mechanical deficiencies in the position of the machine. In either case the isolation of one from the other in an electrical sense is faithfully carried out. A friction clutch may be used for the purpose of direct connecting, but it is not in much use except when special circumstances call for power when the dynamo is not supplying light. These cases are somewhat rare and, as striking exceptions, illustrate the general methods in vogue.

(*To be Continued*).

Is the Corona of the Sun an Electrcial Phenomenon?

(*Continued from Page* 159.)

This behavior of the discharge at all pressures, but very much more striking at pressures higher than the pressure under consideration, seems to support the dissociation theory of Professor J. J. Thomson (*Phil. Mag.*, 1891, Vol. 32, pp. 329, 454, 455.)

II. PHENOMENA INDICATING A DISSOCIATION OF THE MOLECULES.

The following phenomenon appears to be an additional support to this theory:

A close inspection of the discharge going on in the bulbs seemed to reveal the strange fact that the electrical flow was confined to a thin layer of the rarefied gas which is in immediate contact with the inside surface of the bulbs, especially when the e. m. f. was not too far above the critical point, and therefore the supply of the current not too plentiful. To all appearances there was a gliding film of luminous gas in each bulb extending from the mouths of the connecting tube, spreading over the inside surfaces, and ending at the bottom of the bulbs in violently agitated luminous clouds which gave the discharge a hazy appearance. When the vacuum was very good both the film and the cloud were absent. There was no suggestion of a motion on the part of the gas, and the discharge had a clear luminosity. To study this phenomenon more closely the following experiment was performed:

A glass bulb, blown out at one end of a thick glass tube of narrow bore, was filled with acidulated water and placed at the centre of a large glass bottle, as indicated in the figure.

A wide strip of tinfoil was placed on the outside of the bottle, covering about one-third of the surface. The air was exhausted through the tube until the pressure was about 3 mm. The liquid in the bulb and the tinfoil were connected to the secondary poles of the induction coil. When the e. m. f. was not too far above the critical point, the discharge was in form of *numerous, quivering streamers*, which looked like the generators of a conical surface, with the centre of bulb as vertex and the edge of the tinfoil as directing curve. There was *no visible discharge between the bulb and the central parts of the tinfoil.* But the discharge spread out and gradually approached these parts, and at the same time the streamers became less numerous and steadier, giving the discharge a more diffused appearance as the potential gradually increased. When the e. m. f. was gradually brought back to its original value the discharge diminished in intensity but did not return to its original form of distribution. It did that when the e. m f. was considerably lowered below its initial value, which showed that the original distribution was not altogether due to the fact that at any moment the density of the electrostatic charge of the tinfoils was considerably larger near the edges. In this experiment, as well as in the preceding one, the number of streamers, their definition, their quivering motion, and their preference for the paths along which the discharge started increased with the increase of pressure in the vacuum. A discharge (especially in vacua of poor conductivity) will always start between parts of highest electrical density, and each successive discharge prefers the passage along the path of the first discharge, on account of the increased conductivity along this path

But if this increase in the conductivity is due to a rise in the temperature of the gas along the path of the first discharge and to nothing else, how can the fact be explained that a long, thin, discharge streamer, when forced through a poor vacuum, can be maintained steady, and permanent in form, even if the discharge continues for several mintes? It should broaden out continually, and become more and more diffused as the adjacent particles of the air get heated. In my experiments on solitary discharge streamers in poor vacua (see *Am. Jour. of Science.* April, 1892), I did not observe any appreciable widening out, but I did observe a phosphorescent halo around the streamer which, as Professor J. J. Thompson assumes (*l. c.*) was *very probably* due to dissociated oxygen molecules that were ejected from the path of the discharge. (See farther below the effect of a blast on a discharge streamer).

Still another experiment which shows that something of the nature of a dissociation of the gas molecules is going on along the path of the discharge. A thick German silver wire, 60 cm. long, was bent zig-zag fashion into 12 zig-zag parts, and placed in horizontal position at the bottom of a bottle. A wire passing through a rubber stopper in the neck of the bottle connected this zig zag electrode to one of the poles of the induction coil. The other electrode, a small brass sphere, was vertically above the zig-zag electrode, immediately under the rubber stopper. The shortest distance between the two was about 30 cm. The vacuum was about 3 mm. The discharge started between the nearest points of the electrodes, that is, between the lowest point of the sphere and one extremity of the zig-zag electrode. It had the form of a band about 3 cm. wide, intensely luminous at each end, but only very faintly luminous along the intervening three-fourths of its length The length of the less luminous interval increased with the decrease of the e.m.f., but diminished with the increase of the gas pressure; it also seemed to have a different color, but I did not care to examine this point more closely. The phenomenon that interested me more was the gradual creeping of the discharge along the zig-zag electrode from one of its extremities towards the other. It did not increase in breadth but left its trail along the zig-zag electrode in form of a faintly luminous halo, which surrounded this electrode just like a narrow luminous tube. Both the color and the gradual lateral motion of the discharge reminded me very much of the aurora borealis of Feb. 13, 1892. (In this connection it is well to remark that when the e.m.f. is below the critical point this auroral discharge can be started by powerful disruptive discharges of a Leyden jar in its vicinity. This, in connection with observations on coronoidal discharges given in the later part of this paper, may perhaps furnish a clue in tracing the connection between sun-spots and auroral discharges).

(*To be Continued.*)

MR. EDISON'S PERSONAL EXHIBIT AT THE ELECTRICAL EXPOSITION.

Mr. Edison is already actively engaged in preparing a select personal exhibit for the National Electrical Exposition, and Mr. Luther Stieringer has kindly consented to give it his own attention for arrangement. Mr. John Ott, one of Mr. Edison's assistants at the Orange laboratory, is now putting the apparatus in order for shipment.

In telegraphy, Mr. Edison will show stock printers, the phonoplex, the quadruplex, American District system, train telegraphy, and his rote recorder, the first invention he ever made.

In telephony, he will show several varieties of apparatus, including microphones, the chalk transmitter, motograph receiver, etc. He will also show his interesting megaphone, odophone etc.

In lighting, Mr. Edison will show his earliest incandescent lamps, first converter, models of systems of distribution, multiple carbon lamps, centre pole lamps, first chemical meter, lamp Leyden jar, platinum lamp, etc.; also the first fixtures used.

In the line of power transmission, Mr. Edison will exhibit some very early motors and models of great interest.

Among miscellaneous exhibits, may be named his pyromagnetic motor, etheroscope, tasimeter, stages illustrating the evolution of the bamboo filament, magnetic friction devices, early phonographs, his recent fluoroscopes, and his latest phonographs.

He has also in course of construction four sets of apparatus with which experts from his own staff will give exhibitions of the Roentgen rays, so arranged that by using the fluoroscope put into the hands, people can inspect their own anatomy.

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NEW YORK, APRIL 18, 1896.

CONTENTS.

EDISON.

Many a name has stirred the kinks of memory with less force than that of our great inventor, Edison. A world-wide reputation leaves him with but little to wish for, and an unblemished career; everything to be proud of.

The display at the great electrical exhibit will show a few of the more important inventions by which his fame has been spread.

Not that they can add to the eminence of his name—but they will show the minute attention he was apt to give in his desire to complete his work with all possible perfection. Dating from the first telegraphic invention that left his hands the observer will see the drift, growth and sequence of his ideas. The amount of labor the man was capable of will only be indicated, and not shown, by this exhibit.

A man might have acquired prestige with any of the least important of them and then folded his arms in well-earned rest. Not so, Edison; the capacity of this man's genius is not to be measured by ordinary means or by the familiar standard of ordinary men. Few can create and fewer still can execute; and the natural genius whose own unaided efforts have brought him to the front deserves the praise and admiration of all.

Unrebuked by failures, unyielding in his tireless labors, persistent to a degree that speaks of the fiercest inward fires—the truth swells forth with familiar phrase.

> "The heights by great men reached and kept
> Were not attained by sudden flight;
> But they, while their companions slept,
> Were toiling upward in the night."

MODERN SURGERY AND X RAYS.

Modern medicine has received many additions since the last hundred years have rolled away. The growth of all sciences has been sudden, healthy and productive of general good. Since Jenner's departure from traditional practices and his system of vaccination, of inoculation with specific germs, a new light arose on the horizon. The modern surgeon is now armed with an experience that will stand the test of years.

Louis Pasteur made profound researches into the cause of fermentation, of decay; of all the multifold products of exposed and decaying organisms. Koch followed in the tracks of Pasteur with the most complete success. Ever and anon a meteoric gleam would appear and be mistaken for a planet. Brown Sequard, with his mighty elixir, has been all but forgotten, and the hungry hearts that longed for a revived physique must still patiently wait.

Bacteriology has gained a footing in the colleges of medicine, and the ripe results speak highly of Jenner, Pasteur and Koch, its famous originators. But the scientist from other fields is also adding his mite to the general heap.

In paralysis, and the treatment of many foreign growths, there is no better assistance to be sought than that of electricity.

The host of nervous diseases which are still in the field of empirical treatment will ultimately succumb to its proper and systematic application.

The probing for bullets is already a thing of the past.

One of the foremost schools of medicine, the department of physicians and surgeons of Columbia College, have arranged to found an X ray department, equipped with all appliances for the investigation of fractures and the location of foreign substances in the flesh.

It has been a wonderful step forward—this advance from the old, rough-hewn paths to new and promising roads. It means a growth of new ideas, of endless innovations. It means a change of unlimited scope with untold possibilities for the future and fortunate races whose aspirations and successes will surpass our most hopeful expectations.

OUR MODERN MINTS OF THOUGHT.

Many have thought, but how few do think—or care to think. This might aptly explain many of the lost sentiments and unexposed ideas that for lack of vigor or appreciation on the part of their originators are lost. Today money and ideas are almost one, in the opinions of active-minded men. More so today because the ripeness of the age with its great crop of inventions has made the way easier and the applictions greater for their discovery and development. The great masses are becoming more and more the actual, conscious and valuable thinkers of the day. Many a year has passed since the first evidence of inward pith manifested itself, and many a year will pass before this incomparable virtue shall depart. Yes the public, the vast rushing horde do think with an intensity at times that produces a Stephenson, a Watt, a Fulton and an Edison. To struggle against environment clinging to one idea through thick and thin merits some consideration.

Today this is easier in the field of which we speak. One hundred years ago it was almost impossible. Yet the struggle seems to be as fierce as ever, because the objects strived for are harder to obtain. There is no doubt that the public are our modern mints of thought, for they coin the wants of the age and produce the men to supply them.

THE TELEPHONE AND LINE.

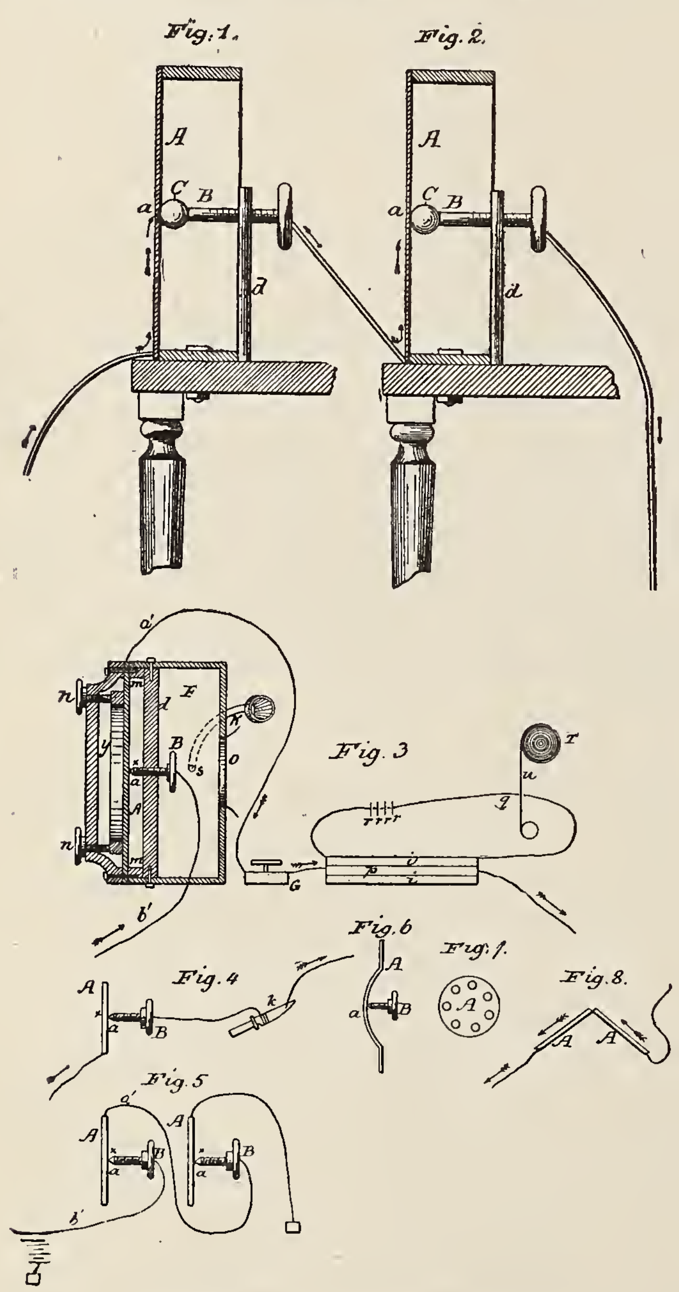
LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

This is in circuit with a receiver and a battery. If the carbon attachment be mounted on a well-built sounding board, the least vibration affects it at once and causes the carbon pieces to jar together, causing a harsh, crushing sound to be heard in the telephone, greatly magnified, and giving the impression of a large body dragged over rough gravel. The ticking of a watch sounds like the heavy blows of a sledge-hammer, and the walking of a fly approaches in loudness the stamp of a horse.

The tap of a finger on the board, scratching of the nail or beating of the pulse, has been heard by means of this contrivance miles away. It is on this principle the transmitter of a telephone has been constructed, and its application is due to the combined efforts of Emile Berliner and Thomas A. Edison.

The compression of the carbon by these slight vibrations allows the current to increase or decrease an imperceptible amount. To the telephone, however, this minute change in resistance means a variation in current that at once produces the extraordinary effects above described.



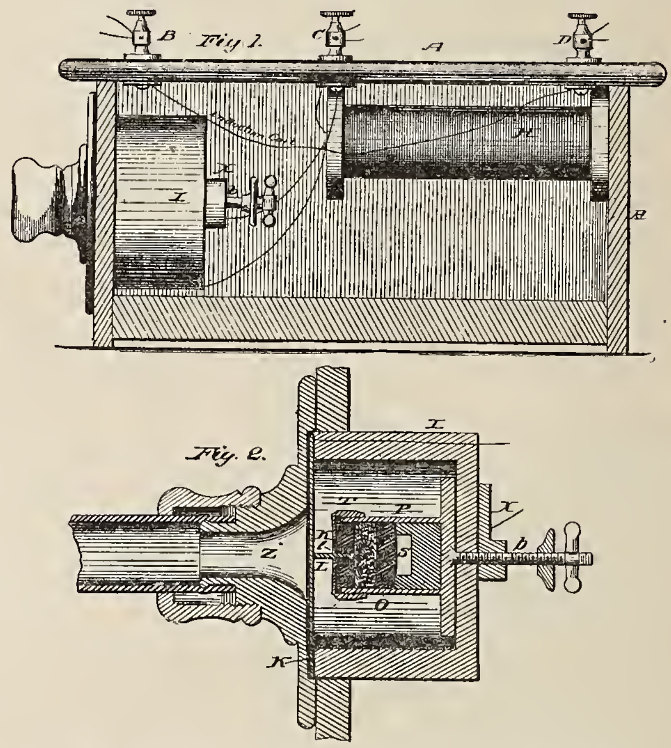
ORIGINAL BERLINER TRANSMITTER.

Transmitter.—The wonderful delicacy of the microphone has therefore been the basis for the construction of a most easily affected piece of apparatus susceptible to sounds otherwise lost. It is, perhaps, the only apparatus by which the voice could be heard over a long distance; and its ready application to telephone practice has been the means of saving the system from other than local use, allowing its extension over hundreds of miles—with the possibility in the future of its further use for transatlantic communications.

The outgrowth of the transmitter from the microphone has been most effective in developing telephony to an extent otherwise inconceivable.

The transmitter, which renders speech clearer than any other piece of mechanism at the other end, is a direct duplication of the microphone. The sounding-board is not necessary, because the minute changes of current experienced by the transmitter at once affect the receiver and cause it to repeat acoustically and instantaneously the uttered sounds.

Principle of Transmitters.—The grating of the carbon pieces upon each other varies the resistance of the contact.



GILLETT'S GRANULATED CARBON TRANSMITTER.

A *decrease* in resistance occurs when the carbons are compressed and an *increase* to the normal status when the pressure is relaxed.

Many forms of telephone transmitters may be built on this basis. A contact which varies with the vibrations of the voice is the means by which a telephonic system may be constructed. The pieces whose resistance is supposed to vary and thus change the current need not necessarily be made of carbon. Many compounds have been used for this purpose of a metallic nature. The changes which occur and shake the enclosed particles are sufficient at times to *pack or compress* them to so great extent as to render the transmitter insensitive to delicate vibrations and consequently useless for long distances. The *varying contact* and *diaphragm* are the subject of much thought by inventive minds.

The diaphragm sounds which fall ineffectively against the diaphragm are lost, and the timbre of the voice with them, for they constitute the distinguishing feature between voice and voice and the most characteristic tones of the ordinary speech.

The carbon contact may be in the form of a tube with a carbon block at each end. The tube is filled with granulated carbon and varies in resistance as the blocks at each end compress the particles within. As remarked before, the degeneration of the transmitter is heralded from the time the carbon begins to pack. Alloys of high resistance metals have been used ground into powder with no success.

Diaphragms make up of laminæ have appeared on the market, but the delicacy of the instrument has not appreciably increased by their use over a long line, and the overtones do not leave their impression on the receiver. A large transmitter is equally ineffective and impracticable, by conveying the sound in greater volume but with corresponding deficiences in tone and evenness.

Carbon Button.—The carbon button upon which Edison's invention rests is attached to a strip of metal, and the vibrations of the diaphragm reach it through the medium of a double-pointed attachment touching the diaphragm and the button. In circuit with the transmitter is a battery and coil of wire. When the transmitter is used, the changes of current vary the magnetism of the coil by increasing and decreasing it. A coil of fine wire wound around the first responds to these changes and sends the minute pulsations over the line to which it is connected.

Lines.—Lines are made either of copper or iron. The usefulness of a line as an efficient means of communication between two distant points depends upon its conductivity and insulation; with good insulation and bad conductivity, or poor insulation and excellent conductivity, the fault is equally reprehensible.

A relation between the conductivity of the line and its insulation resistance should exist and if possible be preserved in practice.

Long lines for either telegraphic or telephonic purposes are necessarily subjected to more leakage, because of the increased number of poles, than short lines. Yet short lines may be very defective, having high resistance in themselves and a character of insulation which compels criticism. Long lines have their insulation pulled down because the many glass insulators to which they are attached each allow a slight leakage to occur and thus in total create quite a flow of electricity to the earth. A relay at the end of a telegraphic line in such a case may be affected or lose its sensitiveness, and a telephone system fail in many respects, by leaving itself open to accident from other power-bearing lines in the vicinity.

(*To be Continued.*)

HORTON'S TELEGRAPH REPEATER.

Mr. L. Horton, Jr., superintendent of the Philadelphia and Reading Railroad Company's telegraph system, has recently been granted letters-patent on a telegraph repeater, which has found great favor among telegraph men generally on account of its simplicity, compactness and effective working, and which has already been adopted by the Lehigh Valley Railroad, Philadelphia and Reading Railroad, and National Transit Company, and is in use on the lines of the Western Union Telegraph Company, Long-Distance Telephone Company, North American Telegraph Company, and Pennsylvania lines west of Pittsburgh.

The distinguishing feature of this repeater is the method adopted for preserving the continuity of the sending circuit while the opposite line is being repeated into, which Mr. Horton accomplishes in a remarkably simple and effective manner by the utilization of the force of gravity, dispensing with all extra armatures, springs or other mechanical contrivances, the holding force being obtained by the *withdrawal* instead of *application* of a local current.

The principle and operation of the repeater will be readily understood by reference to the accompanying illustration in which T and T′ are ordinary repeater transmitters of the usual form, with front and rear contacts arranged for repeating into their opposite lines, and also for actuating the retracting magnets of opposite relays.

R and R′ are main line relays differing from the ordinary relay only in the inclined base and the addition of the local retracting magnets, which are placed directly behind the relay armature occupying the same relative position as the main line magnets in front and acting, when energized, upon the armature as a retractile force (in place of the usual spring) to draw it backward and away from its local contact when the main line current through the front coils is interrupted—and when demagnetized to prevent such movement of the armature, which, under this condition, remains motionless upon its front or local contact regardless of the presence or absence of a current through the main line coils in front; the inclined base, on which the relay rests, causing the armature to retain its forward position by the force of gravity at such times, as both sets of coils may be demagnetized and thus keep its neighboring transmitter closed.

These retracting magnets being adjustable with reference to their position with the armature are drawn toward or away from the latter, as it is desired, to increase or diminish their force upon it, in precisely the same manner as the tension of the spring in the ordinary relay is regulated; and it will be seen that this is the only part of the repeater requiring adjustment.

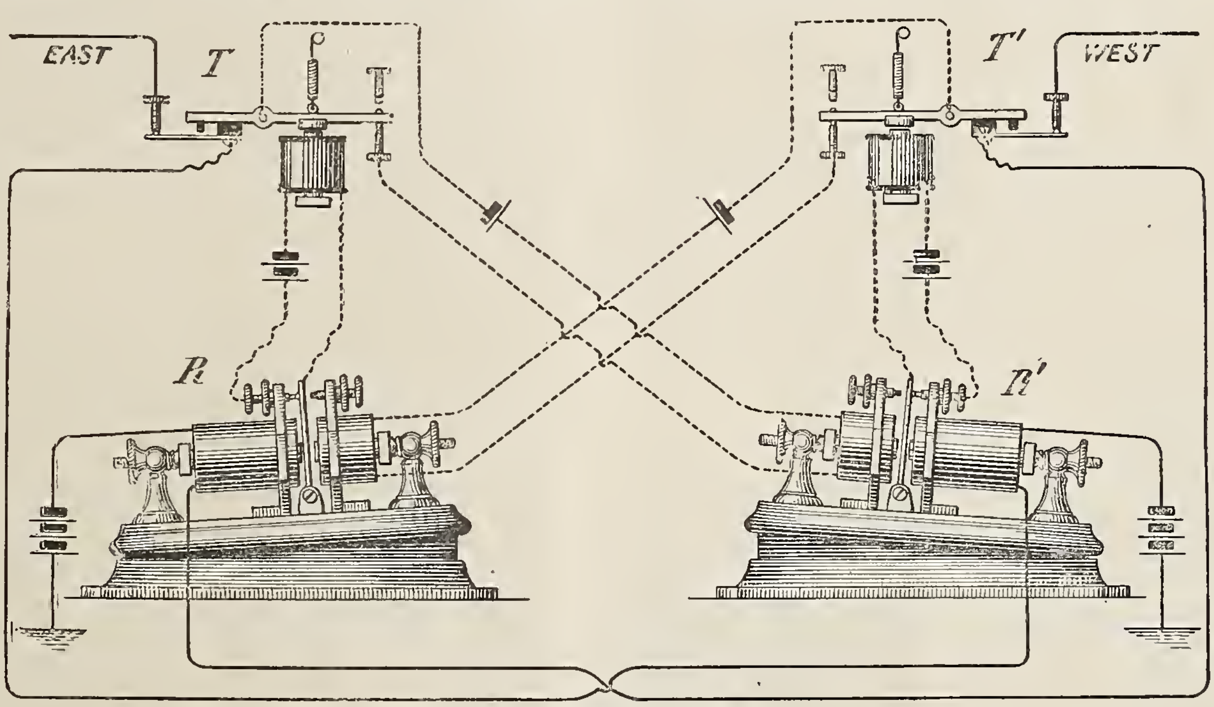
The arrangement of circuits, as shown in the diagram, is as follows: The eastern circuit is brought to the post of transmitter T, and from there, when the transmitter is closed, through relay R′ to battery and ground.

The western circuit is brought to the post of transmitter T′ and thence through relay R to battery and ground.

Both lines being represented as closed, the action of the repeater is as follows:

A distant office on the western line opening its key interrupts the current through relay R, the armature of which is thereupon drawn away from its local contact by the action of its retracting magnet, permitting its neighboring transmitter, T, to open, which, in turn, opens first the local circuit of retracting magnet of relay R′, and next the eastern circuit at its spring contact.

The opening of the entire local circuit demagnetizes the retracting magnet, thereby preventing any movement of the armature of relay R′, which is held against its front or local contact stop by its own weight, when the main line through the front coils is opened an instant later, transmitter, T′, being thus kept closed, preserving the local circuit through retracting magnet of relay R and providing a path for the western circuit through spring contact of transmitter, T′, relay R and battery to ground, to enable the distant western office to close relay R again.



HORTON'S NEW REPEATER.

When the western office closes its key the armature or relay R is again attracted forward, closing the local circuit of transmitter T, which, in turn, closes first the eastern circuit at its spring contact and next the local circuit of relay R's retracting magnet.

The means employed for keeping the relays on either side closed during the time their respective circuits are being repeated into accomplishes the result most effectively without the use of extra armatures requiring special adjustment, the adjustment being thus simplified to that of an ordinary relay.

The advantages of this repeater over other forms are :

First.—Its thorough efficiency as a repeater ; the absence of all extra armatures and springs from the relay, rendering the latter extremely sensitive, and permitting the closest possible adjustment of both relay and transmitter armatures- the play of which may be shortened up so that their motion is scarcely perceptible, which, together with the instantaneous application of the holding force, greatly increases the capacity of the repeater for rapid work. Any very marked decrease in strength of extra local current, which is fatal to the operation of most forms of repeaters, can be instantly and fully compensated for in this instrument by simply giving the adjustment screw of the retracting magnet a turn to bring it closer to the armature, and as the holding force is in no sense dependent upon the strength of current. any variation in the same can have no possible effect upon this function of the instrument.

Second.—The very small amount of attention required during its operation—the adjustment seldom requiring change—and the ease and simplicity of adjustment, which insures better results in the hands of ordinary operators than other forms.

Third.—Small amount of battery required with resultant economy in maintenance ; one cell of extra local for each retracting agent being sufficient as against six cells usually employed in the Milliken, in addition to which it is found that the transmitters can be operated on less battery consequent upon their close adjustment. It is safe to say that a saving of about ten cells of local battery can be effected at each repeater where this form takes the place of a Milliken repeater.

It will be readily seen that this repeater can be divided into half sets and operated in connection with duplex or quadruplex systems with the same facility as other forms not possessing the advatages of this.

THE LECTURERS AT THE ELECTRACAL EXHIBITION.

ELECTRICAL AGE, World Buildimg, New York.

Gentlemen :—Herewith please find partial list of papers and topics to be presented at our nineteenth convention, to be held in this city May 5, 6 and 7.

The sessions will be held in one of the large rooms in the Industrial Building, Lexington avenue and Forty-third street. Hotel headquarters will be the Murray Hill Hotel, Park avenue and Forty-first street, within two blocks of the convention hall. Prices to delegates, $2.00 per day and upward on the European plan ; $4.00 and upward on the American plan.

Very truly yours,
GEO. F. PORTER,
Secretary.

Paper :— " Single-Phase Self-Starting Synchronous Motors," By F. H. Leonard.

Paper: " Results Accomplished in Distribution of Light and Power by Alternating Currents," By W. S. R. Emmet.

Paper :—"Acetylene Gas." By Mr. Ferguson, of the Chicago Edison Company.

Paper :—" Evolution of the Arc Lamp," By L. H. Rogers.

Paper :—" Steam Boilers; Their Equipment and Management,' By Albert A. Cary.

Paper :—" Electrolysis," By Captain William Brophy.

Paper : " Evolution of Interior Conduits: From an Electrical Standpoint," By Luther Stieringer.

Lecture : " The Light of the Future,", By D. McFarlan Moore.

Topic : "The Desirability of a Standard Socket." Discussion to be opened by Alfred Swan.

A NEW EDISON PHONOGRAPH.

The recent announcement of the interesting news that Mr. Edison had bought back from the receiver of the North American Phonograph Company his own property and rights, is followed up by the placing on the market of the new Edison phonograph here illustrated. This machine is being built by the Edison Phonograph Works, at Orange, N. J., and will be handled by the National Phonograph Company, which is now establishing agencies everywhere for its sale.

The new machine conforms in a general way to the older type, but it has two decided elements of novelty. One is that it is operated by a Spring motor, and the other that it is to be sold for about $40.00, thus placing the instrument within the reach of everybody, as a very formidable rival to the limited musical box. Mr. Edison has found that many people are still unable to avail themselves of street current for the dearer phonograph run by electric motor, or else are very averse to bothering with primary batteries, which few of then understand. Hence, he has deemed it advisable to build this new phonograph, which is driven by a simple double spring clockwork mechanism packed away snugly under the lid of the box. The phonograph is similar in design to the standard instrument, but is in reality lighter and thus runs with less frictional loss. The thread of the main shaft is 100 to the inch, so that the standard music and recitation cylinders, of which there are now thousands, can be used. It is so arranged that multiple tubes can be employed, enabling several persons to listen at once ; and it is also furnished, when desired, with a large horn and stand, answering the needs of a large audience. The size over all is 15½ by 7 inches, by 10¾ inches in height. The machine is fitted with a handsome oak case, having a removable half-round top and a drawer for supplies. The whole thing is remarkably compact and the results given by the machine are wonderful in clearness and sweetness of tone. The machine is fitted for reproducing only, but for a small extra charge it is also built to record, or to do both.

INQUIRY COLUMN.

In this column we shall endeavor to answer all questions relating to the science of electricity that may arise in the minds of our subscribers.

(*Q.*)—Spark Coil.

NEW YORK, April 10, 1896.

ELECTRICAL AGE PUBLISHING CO.

Gentlemen :—I desire to operate a spark coil on an ordinary Mesco dry battery for the purpose of lighting *one* gas burner.

The coil to throw the largest spark possible, with the smallest *loss* possible to battery.

The coil must not be more than five inches long. Will you kindly give specifications for making coil, stating size of iron wire to use in core and how much ; also size of copper wire and how much ? S. J. M., N. Y.

(*A.*)—Use No. 18 iron wire for core ; make a bundle about one inch in diameter. Wind this core with one-quarter of a pound of No. 25 B. & S. cotton covered. The greater the length of wire the longer the spark, but the number of cells required would also have to be increased. By using a coil of iron wire, taping and winding your copper wire on it, the effect will be increased.

Telephony in Germany.—In Germany 434 towns are now connected by long distance telphones, which have 110,000 subscribers.

FROM NIAGARA TO NIAGARA IN NEW YORK CITY.

THE completion of the electric power plant at Niagara, and the recent contract made by the city of Buffalo for its delivery within the city limits by June, 1897, makes it appropriate that the work should be signalized in some way at the National Electrical Exposition in May. With this end in view Mr. T. Commerford Martin, in whose fertile brain the idea first originated, and who has succeeded in perfecting arrangements for its complete carrying out, has secured for the exposition a beautiful model of the Niagara river, the town, the power house, and the long discharge tunnel, made to scale by Mr. G. R. Allen, of Philadelphia, under the direction of Dr. Coleman Sellers, for the Hon. Peter A. Porter, of Niagara. The turbines are seen in actual play, operated by water from the canal and driving the big generators. The model is twelve feet by four, and will be given a place of honor on the main floor. The happy thought has occurred that, as little power is required to drive the turbines, it might be comparatively easy to switch on a modicum of current from the Falls plant and actually run the model with it; not as an ideal exemplification of what might be done, but more as a pretty *tour de force*. To get the circuit was the problem, but General Eckert, president of the Western Union Telegraph Company, has authorized Mr. A. S. Brown, the electrical engineer of the company, to place two of their ordinary copper commercial wires at the disposal of the exposition for use every evening, say, for an hour or so, when the weather conditions are normal. This is a generous offer, evincing no small amount of public spirit, and does great credit to the company. Mr. L. B. Stillwell, of the Westinghouse Company, has been asked to co-operate with Mr. Brown in working out the details, it being the intention to use the Tesla two-phase system and Tesla two-phase apparatus. A further suggestion is to hang some American Bell long distance telephones over the exhibit, and thus listen to the roar of Niagara while seeing the model driven by it; steps are now being taken to realize this. Yet another really brilliant idea, quite likely to be executed, is that of Mr. Stillwell to deliver some of the Niagara current to condensers and cable to Europe with it. Mr. Tesla is greatly interested in the whole project, and is lending it his active assistance.

General E. S. Greeley has kindly consented to loan for the purpose of opening the National Electrical Exposition the gold telegraph key used by President Cleveland at the World's Fair in 1893. It is proposed that when Governor Morton closes the circuit through the key to the power plant, instead of signalling merely from floor to floor of the Exposition Building, a circuit shall first be made across the continent and back, through Chicago and San Francisco. The action will practically not be less instantaneous, but it will graphically illustrate the speed with which electricity travels. It is proposed, also, to fire a signal cannon in the same way, at the same time, to announce the event.

Mr. T. C. Martin, chairman of the Historical and Loan Exhibit, advises us that Mr. Edison's personal exhibit for the historical section, consisting of 40 cases, has been received at the exposition building.

Newark, April 6, 1896.

Editor of Electrical Age:

I was very much pleased when I saw the change in the April 4th copy of the Electrical Age; I think il is a great improvement in looks, also in reading matter, and you will find it to be true from your additional number of sales.

Yours truly,
J. W. Gulick,
67 Front Street, Newark.

THE NATIONAL CONDUIT MANUFACTURING CO. SUSTAINS ITS PATENTS IN THE COURTS.

A decision has just been rendered by Judge Townsend, in the United States Court, District of Connecticut, sustaining the patents of the National Conduit Manufacturing Company in their suit against the Connecticut Pipe Manufacturing Company. The decision perpetually enjoins the Connecticut Company from infringing the patents on the well-known cement-lined tubes, which patents are owned and controlled by the National Conduit Manufacturing Company.

The case was argued by very able counsel on both sides, and the decision is of very great importance to the electrical public generally on account of the many millions of feet of said cement-lined pipe already laid in the United States and Canada by the National Conduit Manufacturing Company, and the large quantities which they are at present installing and the peculiar adaptability of cement-lined pipes for underground subway system.

This decision gives the National Company complete control of the field, and additions to their already large factories are now in course of construction in order to meet the demands of the business.

AMERICAN INSTITUE OF ELECTRICAL ENGINEERS.

McFarlan Moore.

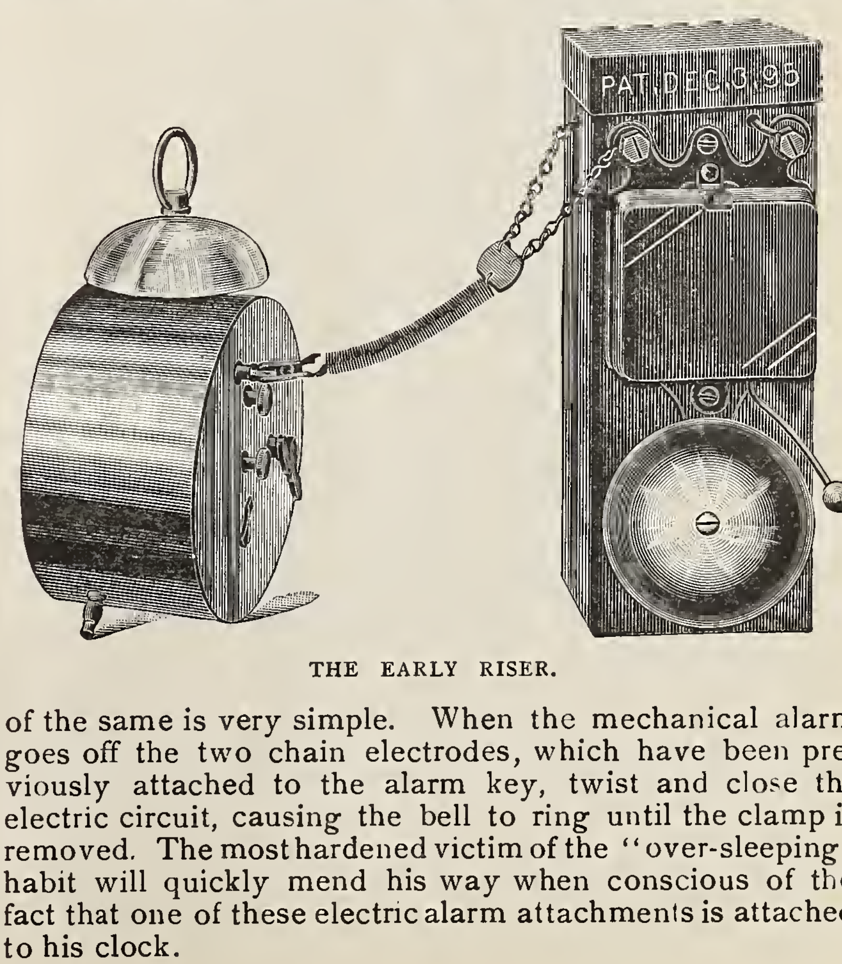
Editors:—The 105th meeting of the Institute will be held at 12 West 31st street, New York City, on Wednesday, April 22, at 8 p. m.

A paper will be read by Mr. D. McFarlan Moore, of Newark, N. J., on "Recent Developments in Vacuum Tube Lighting," accompanied by experiments. The hall will also be lighted by these tubes.

Yours truly,
Ralph W. Pope, Secretary.

A SURE CURE FOR OVER-SLEEPING.

One of the most ingenious early risers' electric alarm attachments now on the market is that manufactured by the Manhattan Electrical Specialty Co. The attachment can be attached to any ordinary alarm clock and the operation

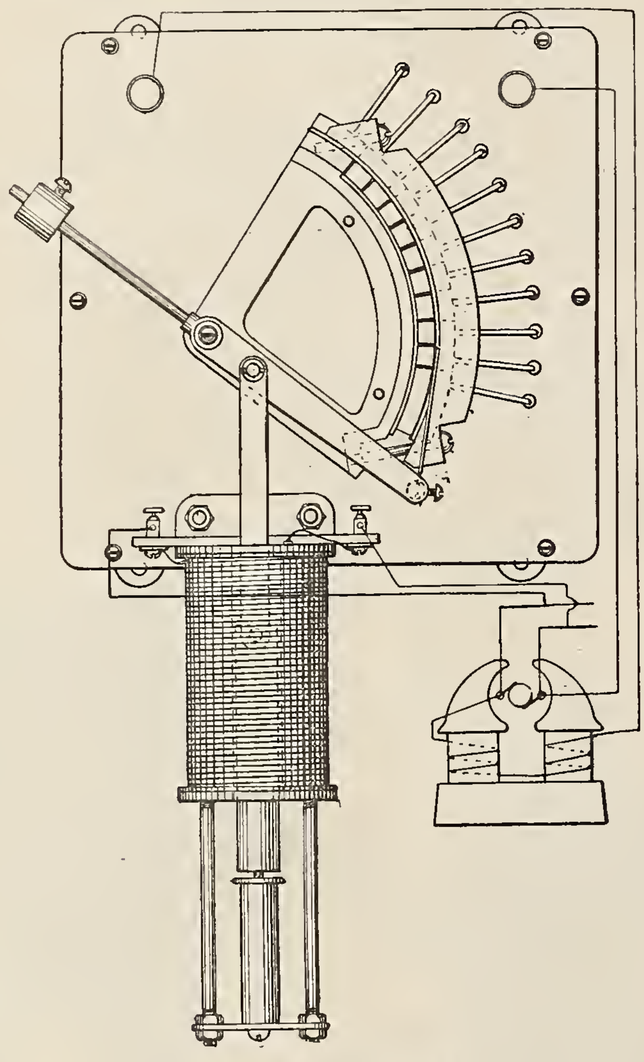


THE EARLY RISER.

of the same is very simple. When the mechanical alarm goes off the two chain electrodes, which have been previously attached to the alarm key, twist and close the electric circuit, causing the bell to ring until the clamp is removed. The most hardened victim of the "over-sleeping" habit will quickly mend his way when conscious of the fact that one of these electric alarm attachments is attached to his clock.

VOLTAGE CONTROLLERS FOR VARYING SPEED OF DYNAMOS.

For any applications of electricity a constant potential is an imperative necessity. The operation of a plant of incandescent lamps is a case in point. All the difference between financial success and failure of a plant may frequently be traced to good or bad regulation at the generators. A variation of only a small per cent. makes an enormous difference in the life of the lamps. The operation of most systems of power transmission also demands constant potential to be maintained at some part of the system, and it is not infrequent to find in the power stations of today a man constantly employed watching the voltmeter and making hand regulation to counteract the changes that are constantly occurring. The compound winding of the generator does not remove the difficulty. A change of speed changes the voltage; the compounding does not compensate for that, and furthermoie if the speed is constant and the compounding is therefore supposed to secure perfect regulation there is sometimes a considerable discrepancy, owing to two different causes; one of these is the change of temperature of the coils and the other is the hysteretic quality of the iron of the field magnet. A generator running at exactly its normal speed and normal load may at one time develop a voltage higher than the normal and at another time a voltage lower than the normal, according as the conditions of load have previously been higher or lower. The best of generators give a higher voltage when running on the strong side of the



VOLTAGE CONTROLLER.

hysteresis loop than when running on the weak side, and no compounding can remedy the difficulty.

A perfect automatic regulation can only be secured by something outside of the machine itself, and recognizing this fact the Belknap Motor Co. have put on the market a regulator which is shown in the accompanying cut, and one which is meeting with unqualified success both on account of its effectiveness and its extreme simplicity.

The invention originated with W. H. Chapman, the company's electrician, in connection with a lighting plant operated by water power at Bar Mills, Mo. The water-wheel had no governor and the changes of load were such as to cause the speed at the dynamo to vary from 900 to 1400 R. P. M. when no change was made at the water-wheel gate. The regulator shown herewith was devised and applied with perfect success, and in spite of these extreme variations in speed, the potential is kept within one and a half volts of the required point on the 110-volt circuit. The device consists essentially of a field rheostat and a solenoid to operate it. The resistance coils are mounted on mica covered pipes placed inside of an iron box with slate front. On the front of the box is mounted a series of contact segments connected to the resistance coils and arranged in the arc of a circle, at the centre of which is pivoted a lever. One arm of the lever carries a stud and contact brush that moves over the peripheral surface of the segments. The other arm of the lever carries an adjustable weight by which the voltage may be adjusted to any desired point and the regulator will then keep it at that point. The resistance is connected into the shunt field circuit and the contact brush short circuits more or less of it according to its position.

The solenoid that operates the lever-arm is built large, so as to make the friction of the moving parts enter as a small factor of the total power of the solenoid, and the solenoid and its core are of such proportions that the lifting-force through a range of a couple of inches is almost exactly constant. A solenoid constructed to expand 55 watts of energy is found to operate this style of rheostat on changes of two per cent. in voltage, and larger solenoids operate with greater accuracy. The solenoid is connected as a shunt to the armature circuit and may be connected to the potential wires that lead to some distant point of the system, and the apparatus then makes allowance for the loss in the line and secures all the benefits of an over-compounded generator run at absolutely steady speed, even though it actually be attached to a plain shunt machine and that machine be run at a speed varying 50 per cent. or more. This method of regulating is not only adopted as a perfect supplement to the compound winding, but is adopted to entirely displace it and, in the near future, the extensive use of plain shunt wound machines supplemented by this simple regulator is an assured fact.

CITIZENS' TELEPHONE COMPANY PLACED ORDER FOR 'PHONES.

THE LARGEST EVER GIVEN.—AMERICAN ELECTRIC AND TELEPHONE COMPANY, THE SUCCESSFUL BIDDER, WILL SUPPLY 1,800 INSTRUMENTS, COSTING $35,000.

After a long, exhaustive contest, the executive committee of the Citizen's Telephone Company last night awarded the contract for 1,800 telephones to the American Electric and Telephone Company, of Kokomo, Ind. The contest has waged almost continuously for the past four weeks, with representatives of a dozen of the largest telephone makers in the country in attendance. Messrs. Fisher and Ware, of the Citizens' Company, were desirous of obtaining the best instruments to be had, and it was largely due to their caution in this regard that the awarding of the contract was so long delayed. The machines selected embrace the full long-distance equipment and every modern improvement. General Manager P. C. Burns. and Special Agent S. J. Bear signed the contract in behalf of the Kokomo concern. Shipping of the 'phones will begin in about two weeks, and it is expected that the new exchange will be ready to respond with the familiar "number, please," about April 15. The 1,500 subscribers already secured cannot, however, all be supplied before May 1. The contract placed last night is the largest ever awarded by an independent exchange in America, and represents a cash outlay of nearly $35,000. The Kokomo company is also supplying the switchboard equipment.—Grand Rapids *Democrat*, March 17, '96.

We want all of our readers to feel free to ask questions. All it will cost you is a two-cent stamp, We are always glad to be of any service to our friends. Don't hesitate, but come right forward. The smartest of men are always asking questions.

AN UNEQUALLED CIRCUIT BREAKER.

Notice.

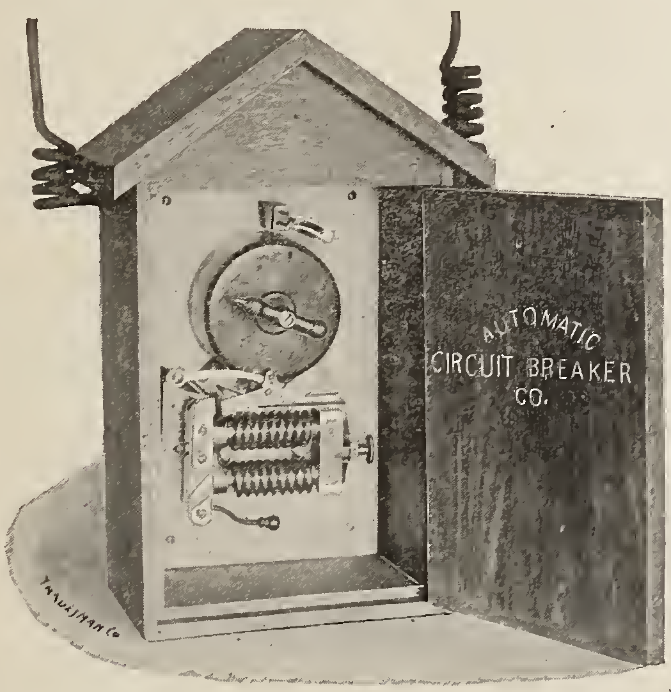
ARMOUR & COMPANY,
GENERAL OFFICES, 205 LA SALLE ST.
CHICAGO, ILL., Feb. 24, '96.

THE NEWAYGO AUTOMATIC CIRCUIT BREAKER CO.,
MR. A. SHILLINGLAW, AGENT,
105 LAKE STREET, CITY.

Dear Sir:—Our experience with different circuit breakers has, after a severe test of yours, convinced us that you carry out all you claim, and that our dynamos and motors are fully protected by their use.

Enclosed you will find an order for seven (7) more to complete our equipment.

Yours truly,
ARMOUR & COMPANY,
JAMES P. MALIA, Electrician.



AUTOMATIC CIRCUIT BREAKER.

THE HAMILTON & LINDENWALD ELECTRIC TRANSIT CO.
HAMILTON, O., Feb. 24, 1896.

AUTOMATIC CIRCUIT BREAKER CO.,
NEWAYGO, MICH.

Gentlemen :—Yours of the 19th inst. received. Referring to your automatic circuit breaker, would state that the H. L. E. T. Co. have one of your 500-v 500-amp. switches installed in their power house for the past year. It has given perfect satisfaction, and is thoroughly reliable. We have nothing to fear, either from short circuits or lightning; in fact, we never had a shut-down or a burn-out last spring in those severe lightning storms. It works like a charm and speaks for itself.

Yours truly,
Per W. J. BOWMAN.

UNITED STATES PATENT OFFICE EXHIBIT.

The United States Patent Office is arranging to make at the electrical exposition a fine display of electrical models, etc., which will be peculiarly interesting and instructive as bearing upon the growth and development of electrical invention. A special representative of the Patent Office will be in charge of this exhibit, which will be under the general care of the historical and loan exhibit committee.

NOTICE.

F. H. Doane, representing Frank Redlin & Co., is in town. Redlin & Co. make a specialty of repair work and second-hand supplies at 180 Sumner street, Boston, Mass.

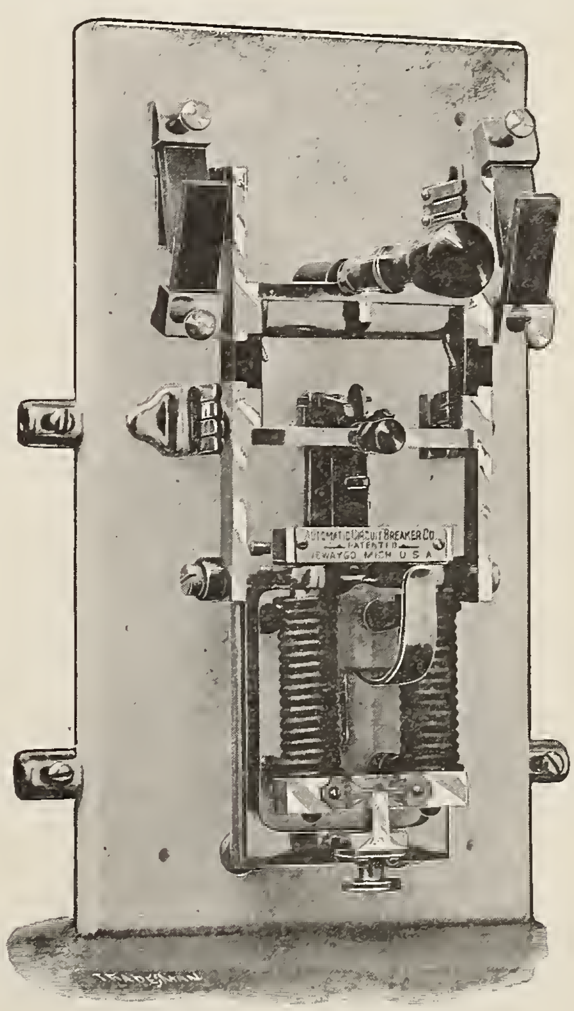
WARING AGAINST WESTINGHOUSE.

MR. R. S. WARING, formerly prominently and actively connected with the Standard Underground Cable Co., and the original owner of many of its valuable patents, has recently entered suit against Mr. George Westinghouse, Jr., to recover the value of 10,000 shares of stock in said company. The well-known names of the litigants, and the large amount involved, make the case one of considerable interest, although the outcome cannot in any way affect the company itself, or its policy, as the litigation is purely a personal matter between two of its stockholders as to an accounting.

Mr. Waring claims that the stock in question was transferred by himself to Mr. Westinghouse at the time that Mr. Westinghouse became connected with the company, in March, 1886; and that the stock was to have been held in trust and for his benefit. In the course of the testimony many depositions were submitted from electrical experts and large users of underground cables as to the high character of the Waring cable manufactured by this company. The depositions also showed that the cable made today is practically the same cable as was made in 1886, and that it is generally admitted to be the best cable known to the electrical art at the present time.

The defence of Mr. Westinghouse to this suit was substantially that the stock in question had been given him outright to secure his active interest and influence in favor of the company, which was then a new undertaking, and that there was no agreement or understanding that he held the stock for Mr. Waring, and that nothing is due to Mr. Waring on account thereof.

The case was brought to a sudden termination on the 9th inst., when the plaintiff withdrew his suit. The testimony on the main issue—viz.: whether Mr. Westinghouse



AUTOMATIC CIRCUIT BREAKER.

should account to Mr. Waring for the stock in question, was largely in favor of Mr. Westinghouse up to the time the suit was withdrawn.

Brill & Co., of Philadelphia, have received a contract for the erection of a trolley road in Cape Town, South Africa, the Westinghouse Co. supplying the materials—the road being three miles long.

Interesting Facts in Science.

Dr. Crookes' Experiment.— The peculiar light produced within a tube with a low exhaustion—the negative pole becomes surrounded by a narrow layer and then a dark-bluish space; the rest of the tube is filled with reddish-yellow light separated into bands by dark spaces. When the light strikes against the glass it excites the brightest fluorescence. When the vacuum is almost complete, a most remarkable change occurs. The light proceeds from the electrode in straight lines and does not follow the bend of the tubes. With whatever electrodes the positive pole is connected, the rays proceeding in straight lines strike the opposite side and excite there the brightest fluorescence. A screen of mica in their path stops the rays and forms a shadow at the other end.

The Fluorescence of Precious Stones.—When the discharge from a Geissler tube is directed upon the diamond it emits a magnificent green fluorescence; the ruby becomes brilliantly red and the emerald a magnificent carmine.

Radiant Matter.— Crookes believes that matter assumes an ultra gaseous state, which he calls radiant matter. The ordinary distance through which a molecule moves has been estimated at .000095 of a millimeter when under pressure. If the pressure is greatly removed, and the exhaustion brought to a point equal to one-twenty millionth of an atmosphere, the molecules project themselves over a distance equal to the entire length of the bulb without meeting each other. The glass, therefore, receives the blow, and becomes luminescent under the circumstances, according to Crookes.

Resistance of Gases.—Air offers a greater resistance than hydrogen. A spark which passes in hydrogen across a distance of 5.6 millimeters will only strike across a distance of three millimeters in air.

New Corporations.

Loda, Ill.—Loda Electric Light, Water and Telephone Co., of Loda; Capital, $10,000. Incorporators: E. S. Sherdon, W. L. Kinsman, N. P. Goodell, John T. West, A. Swanson and Frank F. Butzow.

Redwood, Cal.—The Redwood City Electric Light Co. Capital, $50,000. Incorporators: George H. Rice, Robert Brown, Ludwig P. Sehrens, George C. Ross and others.

Little Rock, Ark.—The Postal Telegraph Co. has been incorporated with C. P. Cummings, president; W. P. Davison, secretary, and Geo. W. Clark, treasurer. Capital stock, $1,000,000; to conduct telegraph lines, etc.

Martinsburg, W. Va.—The Martinsburg Electric Co. has been organized to succeed the Edison Electric Illuminating Co., W. W. Houseworth, secretary and manager; Capital stock, $50,000.

Old Forge, Pa.—The Old Forge Electric Light, Heat and Power Co. Capital, $5,000. Directors: Samuel Broadhead, Jr., William Rapp, Thaddeus J. Stewart, George Drake, Jr. and Francis R. Coyne, of Old Forge.

Wheeling, W. Va.—The Dillon, Wheat & Hancher Electric Co., incorporated to deal in electrical machines and to carry on the business of generating and supplying electricity for heating and lighting purposes. Capital, $25,000. Incorporators: I. G. Dillon, A. A. Wheat, C. N. Hancher and others.

Camden, N. J.—The C. C. Clark Co., which proposes to build steam and electric plants, was incorporated in Camden, April 7.

New York City.—Bergen Beach Light and Power Co., to light Bergen Beach; Capital, $25,000. Directors: Van Wyck Rossiter, of Nyack; H. H. Porter, Jr., of Lawrence, and Fredk. Giblin, of Brooklyn.

New York City.—Thomas R. White, 7 Lenox avenue, will erect a twelve story brick office building at 95 and 97 Liberty street, at a cost of $240,000.

Harry Chaffee, 365 West 23d street, will erect an eight-story brick store and office building at 29-33 19th street, at a cost of $350,000.

Marion, Ky.—Estimates for a complete outfit for an electric light plant are wanted by R. E. Bigham.

Telephone Notes.

Hampton, Va.—The application of the Southern Bell Telephone Co., for permission to erect poles and run wires, was referred to the street committee.

Harrodsburg, Ky.—A telephone exchange will soon be in operation in Harrodsburg, and there are strong probabilities of the lines being extended to High Bridge and Lawrenceburg.

Newark, N. Y.—At the regular meeting of the Board of Aldermen of this city held at the City Hall, a franchise was granted to Robert F. Randall to build and construct a public district telephone throughout the town.

Weimar, Tex —The Weimar City Council met in regular session and, after transacting business, granted permission to J. B. Holloway to erect a city telephone system, as soon as Mr. Leidolp completes the electric light plant now under contract, to be done by June 1, next.

East Bangor, Pa.—A telephone line has recently been surveyed and staked off between Richmond and East Bangor. The line will be erected in the near future.

TELEPHONE PATENTS ISSUED APRIL 7, 1896.

557,588. Telephony. William C. Lockwood and John M. Lockwood, Brooklyn, N. Y., assignors of one-half to Josiah Tice, New Brunswick, N. J. Filed Oct. 29, 1894.

557,741. Telephone-Transmitter. Walter L. Wilhelm, Buffalo, N. Y.; William Wilhelm, guardian of said Walter L. Wilhelm, assignor of one-half to Byron J. Tillman, same place. Filed Nov. 21, 1895.

557,898. Lock-Out System for Telephone-Lines. Chas. E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed July 22, 1895.

FOR UPTOWN TELEPHONE SUBSCRIBERS.

An uptown branch of the Contract Department of the Metropolitan Telephone and Telegraph Company has been established at 113 West 38th street (one door from Broadway), where all business relating to the supply of telephone service can be transacted as readily as at the main office at 18 Cortlandt street. There are 14,500 telephone stations in New York City. Metallic Circuit Service, Rapid, Efficient, Permanent, can be had from $75 a year.

NEW TELEPHONE COMPANIES.

Fitzgerald, Ga.—The Colony Telephone Co. has been organized with D. H. Ledbetter, of Cordele, as president; F. S. Bander, vice-president, and A. T. Curry, secretary; to establish a telephone system.

Greenville, Va.—A company has been formed to construct a telephone system. J. Touberman, president, and H. C. Palmer, secretary.

Possible Contracts.

Pensacola, Fla.—A company of New York capitalists is seeking from the Council a franchise for an electric street railway line. Sterritt Tate is representing them, and at the meeting held April 1 he appeared before the council and stated that the company was prepared to begin work at once, if the franchise should be granted.

Port Richmond, S. I., N. Y.—The Port Richmond trustees granted a supplementary franchise to the Staten Island Electric Railroad Co., to build a single track from Richmond avenue to Mariner's Harbor, with a provision that a double track shall be completed before August 1. The company agreed to proceed at once with the work of construction.

New York City.—The chemistry building for Columbia University, the plans of which were approved by the trustees at their meeting, is to be erected as a memorial to the late Frederick Christian Havemeyer. Estimated cost, $400,000.

New York City.—The National Life Insurance Co., of Hartford, Conn., has purchased the property at northeast corner of Park Row, and it is probable that a building will be erected thereon next year.

Santa Cruz, Cal.—The Big Creek Power Co., which is to generate electricity by water-power, is considering a proposition to furnish 100 horse-power daily to the San José Electric Light Co. The expense of extending the line to San José is $20,000.

New Brunswick, N. J.—The plan of introducing electricity as a motive power on the branch road of the Pennsylvania Railroad Co. from New Brunswick to East Millstone, a distance of eight miles, is being discussed.

Belvidere, N. J.—The Mountain Lake Co. incorporated. Capital, $30,000. Incorporators, W. C. Falkner, M. W. Weller, G. R. Givens and others. The company proposes building a large hotel on the banks of Green's Pond as a summer resort.

Pittsburgh, Pa.—Architects Alden & Harlow have prepared plans for the erection of a business block on part of Mr. Phipp's property on Penn avenue, to be completed by November. It is stated that the Trustees of the First Presbyterian Church on Wood street have decided to erect a monster office building on a portion of the church property. Estimated cost of same, $500,000.

New York City.—Robert Maynecke is drawing plans for rebuilding the two upper stories of the *Times* Building at Park Row, Nassau and Spruce streets, and adding two more stories, making it a seventeen-story building.

FROM AFAR.

AUSTIN, Texas, is growing, and so is the Austin Electrical Supply Co., of Austin, Texas. Mr. Jos. E. Johnson, manager of the above company, was in town last week looking up new electrical productions and placing orders very generously. He reports a large and growing trade throughout his state. The Austin Electric Light and Power Co. have a powerful water-power plant and are supplying current for light and power in that section.

CANADIAN LETTER.

BY OUR MONTREAL CORRESPONDENT.

Electric Railways.

Ottawa, Ont.—An electric railway is projected to extend from Bell's Corners to Richmond West, a distance of ten miles. John Moodie is one of the promoters.

Toronto, Ont.—For some time negotiations have been pending for the purchase of an electric railway franchise on the Niagara Peninsula It is said that a syndicate composed of capitalists from Toronto, Montreal and New York is now being formed to secure the franchise, the intention being to build the line at once.

St. Catharines, Ont.—The St. Catharines Street Railway Co. is making a number of improvements; new rails and new overhead cables and brackets put on.

Brockville, Ont.—A meeting of the directors of the Brockville Street Railway Co. took place the other day when the agreement with the town was formally ratified. According to the agreement, work is to be commenced on the construction of the railway not later than May, 1897, one mile to be completed and in operation a year from that date.

St. Stephen, Ont.—Under Jos. McVey the extension of the St. Stephen and Hilltown Railway is making good progress.

Harrow, Ont.—The South Essex Electric Railway Company applies for an Ontario charter to build from Amherstburg to Harrow, Ont.

Campbellton, N. B.—The Campbellton, N. B., Electric and Telephone Co. are enlarging their plant and are contemplating an extension to Dalhousie.

ROENTGEN RAYS.

What is Light?—We are absolutely certain that light is a periodic disturbance in some medium, periodic both in space and time; that is to say, the same appearances regularly recur at certain equal intervals of distance at the same time, and also present themselves at equal intervals of time at the same place; that, in fact, it belongs to the class of motions called by mathematicians undulatory or wave motions.

Light and Electricity.—James Clerk Maxwell, a genius of undisputed power, established the relationship between light vibrations and electromagnetic phenomena; that they are different manifestations of one and the same class, and that light is, in fact, *an electromagnetic disturbance.*

Faraday's Experiment.—The work of this great experimentalist, and his numerous attempts to prove that magnetism and light have some connection between them, was the basis for future work to Clerk Maxwell, Hertz, Lord Kelvin, Tesla and even Roentgen. Faraday himself did not have a clear idea of the real issue at hand, but simply labored with the hope of either affecting light by means of a magnetic field or the converse.

Selenium and Light.—The remarkable action of light on selenium has been for many years the subject for much discussion. It was first noticed in the laboratory of Willoughby Smith by an assistant. When a ray of light strikes a piece of selenium in circuit with a galvanometer its conductivity increases. The light of a candle is sufficient to bring down its resistance to about one-fifth of its original value.

The Universal Ether.—The expanse of space in all its infinity is filled with a continuous homogeneous connecting substance called ether. It connects all particles, penetrates all interstices and enables the effects called light, heat, magnetism and electricity to come within the scope of our consciousness. It is probably the means by which gravitation may be explained and atomic or molecular reactions interpreted. It has been thought by many of the greatest minds of the past and present to be identical with matter itself—that the action of force upon ether makes it display, through the spinning of its particles, the appearance of matter. A veil of mystery shrouds these marvels from our minds at present, but we hope in the future for their solution.

Niagara Falls, Ont.—The Niagara Falls Park and River Electric Railway carried last year 499,015 passengers, which is a large increase over 1894. The receipts were $65,734, and cost of operation, $40,630.

J. Alcide Chausse.

ELECTRICAL and STREET RAILWAY PATENTS

Issued April 7, 1896.

557,534. Pressure-Alarm for Gas-Pipes. Francis S. Baker, Chicago, Ill. Filed Jan. 17, 1895.

557,535. Electric-Car Truck. Charles F. Baker, Boston, Mass. Filed Sept. 16, 1895.

557,598. Car-Fenders. Frank Oakden, Dunedin, New Zealand. Filed Jan. 26, 1894.

557,600. Insulator. Cyrus A. Peterson, Stratton, Nebr. Filed Nov. 11, 1891.

557,606. Electric-Arc Lamp. Theodore Reyman, New York, N. Y. Filed July 9, 1895.

557,648. Electric-Arc Lamp. Harold E. Bradley, Pawtucket, R. I. Filed Feb. 6, 1896.

557,650. Electric Indicator for Hot Journal Boxes. William B. Chockley, Denver, Colo. Filed Mar. 15, 1895.

557,657. Electric Railroad. William R. Elliott, Chicago, Ill., assignor of two-fifths to Isaac C. Robbins and Charles A. Emmons, same place. Filed June 27, 1895.

557,678. Commutator-Brush Holder. Robert Hirsch, Milwaukee, Wis. Filed July 1, 1895.

557,690. Wire-Connector. Charles H. McIntire, Newark, N. J. Filed Feb. 15, 1896.

557,708. Testing Apparatus for Multiple Switchboards. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed June 19, 1888.

557,714. Electric Motor. Imle E. Storey, Hornellsville, N. Y., assignor to the Storey Electric Drill and Power Company, of Colorado. Filed Jan. 28, 1893.

557,732. Adjustable Incandescent-Lamp Holder. Edward Wade, Lawrence, Mass. Filed July 1, 1895.

557,749. Automatic Electric Railway-Signal. William W. Alexander, Kansas City, Mo., assignor to the Gill-Alexander Electric Manufacturing Company, same place. Filed Dec. 10, 1889. Renewed Aug. 29, 1895.

557,750. Car-Fender. Leonidas E. Anderson, Pittsburgh, Pa. Filed May 18, 1895.

557,777. Electric Switch. Abraham K. Dresher, Worcester, Pa. Filed Apr. 24, 1895.

557,779. Galvanic-Battery Jar. Caleb C. Dusenbury, New York, N. Y. Filed Dec. 23, 1895.

557,784. Closed Conduit and Appliance for Electric Railroads. William R. Edelen, Washington, D. C. Filed Nov. 16, 1895.

557,809. Electrically-Operated Agricultural Machine. Israel Hogeland, Chicago, Ill., assignor of one-half to Paul E. Berger, same place. Filed Nov. 22, 1895.

557,819. Winding Device for Electric Cables in Elevators. David E. Houser, Fort Wayne, Ind. Filed Aug. 16, 1895.

557,827. Trolley Mechanism. James M. Kennedy, Hollidaysburg, Pa., assignor of seven-eighths to Thomas F. Johnston and Henry L. Bunker, same place, and William F. Gable and Galen Hemperly, Altoona, Pa. Filed Nov. 23, 1895.

557,830. Conduit for Electrical Conductors. John M. Kinney, Boston, Mass. Filed Aug. 6, 1895.

557,848. Electric Switch. Paul E. Marchand, Ottawa, Canada. Filed Nov. 2, 1895.

557,854. Automatic Battery-Reverser. Paul Minnis, Mobile, Ala., assignor of one-half to the Home Telephone Company, same place. Filed Feb. 17, 1896.

557,860. Hanger for Trolley-Wires. William A. McCallum, Avondale, Ohio, assignor to Charles Andrews, Cincinnati, Ohio. Filed June 24, 1895.

557,869. Armature-Core. Granville F. Packard, Fort Wayne, Ind. Filed Dec. 26, 1895.

557,881. Insulator. Hannibal W. Rappleye, Philadelphia, Pa. Filed Feb. 24, 1896.

557,888. Shade for Electric Lights. Willis E. Robinson, Faribault, Minn., assignor to himself and Frank A. Bush, same place. Filed June 20, 1895.

557,897. Car-Fender. Adam Scheid, Harrison, N. J. Filed Nov. 13, 1895.

557,920. Storage Battery. Alexander F. Vetter, New York, N. Y. Filed Aug. 30, 1895.

557,930. Car-Fender. Sylvanus D. Wright, New York, N. Y. Filed June 13, 1895.

557,951. Car-Fender. Henry Boemermann and Ole Olsen, Brooklyn, N. Y. Filed Dec. 13, 1895.

557,957. Rotary Field-Motor. Charles S. Bradley, Avon, N. Y. Filed Sept. 30, 1895.

557,960. Electric Propulsion of Cars. Archibald H. Brintnell, Toronto, Canada. Filed May 1, 1895.

558,016. Electric Rail-Bond. Bruce Ford and William Jens, Johnstown, Pa. Filed July 22, 1895.

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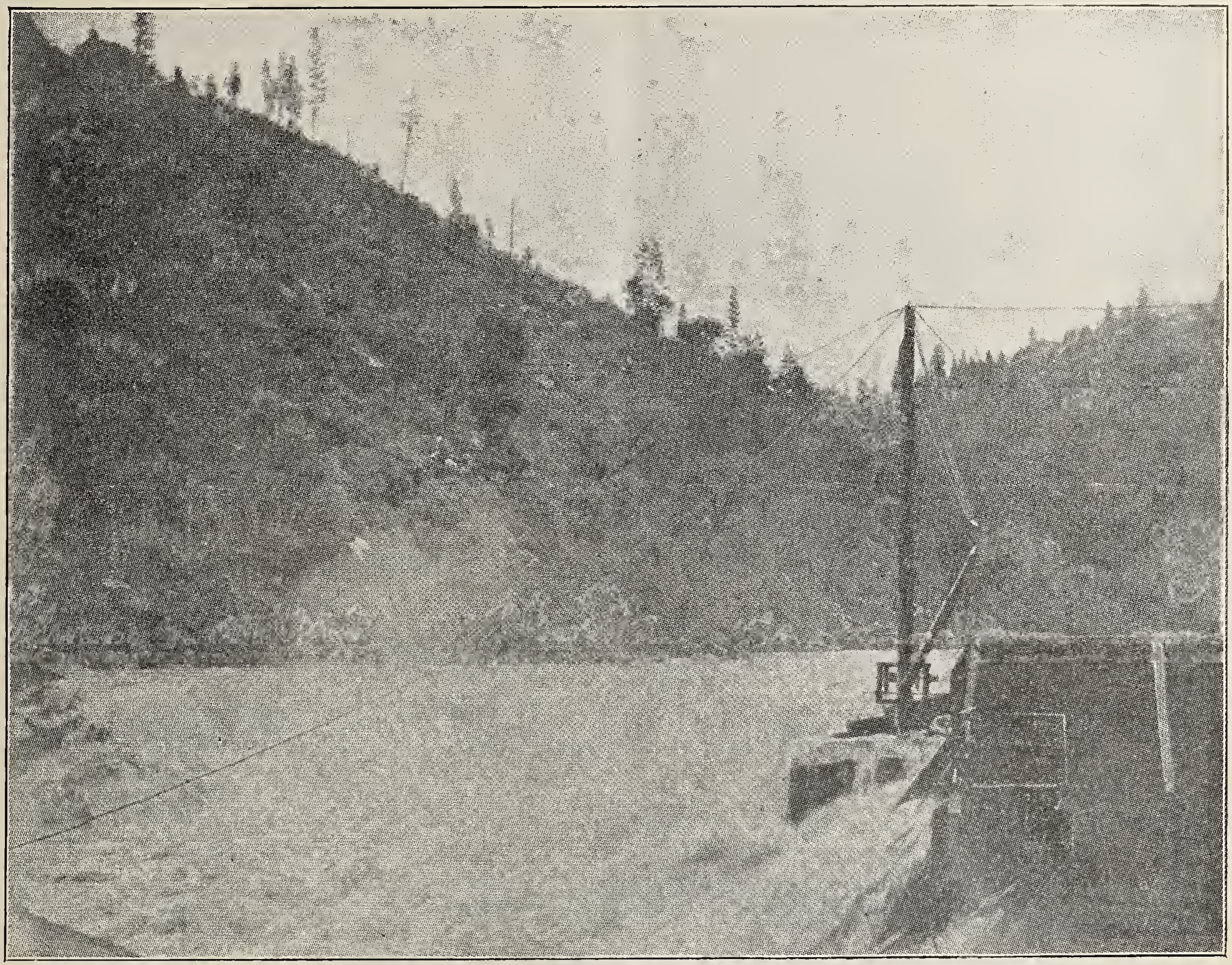


South Yuba River. ELECTRIC WATER-POWER PLANT. Erected by Hasson & Hunt.

THE UTILIZATION OF WATER-POWER.

There is enough water-power being wasted each day to run the machinery of this earth for a year. Not only is this especially true for water-power alone but for the winds and tides and the very waves of the ocean. It would need but a slight calculation to roughly estimate the vast sources of power still unused. The daily dissipation of power occurs in such abundance that it seems to be but due to negligence on our own part in so allowing it. John Ericsson was impressed with the loss of energy resulting from radiation and built his solar engine to gather up the sun's rays and turn them into useful power. It is a common sight to see the familiar country windmill slowly swinging around in the breeze, either running a well or pumping water for domestic use; and still more quaint is the old-fashioned water-wheel, now fast disappearing from the country side, with its creaking appurtenances and battered appearance.

These are the last signs of olden times, the fading reminiscences of early days.

Of the vast possibilities of water-power but little doubt exists. There are a thousand things to be done with it, and a town may grow up over night by the side of a heavy falls. In fact, the first impression that remained with travellers and explorers was the vast power being daily wasted in the Zambesi Falls of the Dark Continent. It is not enough that the power is there, but the pictured possibilities at once clothe the spot in civilized garb. The pavement, roads, homes and factories of a thriving town appear in our mind's eye. The falls become a leaping stream of liquid gold, sending its wealth by means of wires through a thousand and one hidden paths to the consumer's door.

In our own country there are probably several thousand falls of water, aggregating in total about half as much power as Niagara with all its hustling torrents of water.

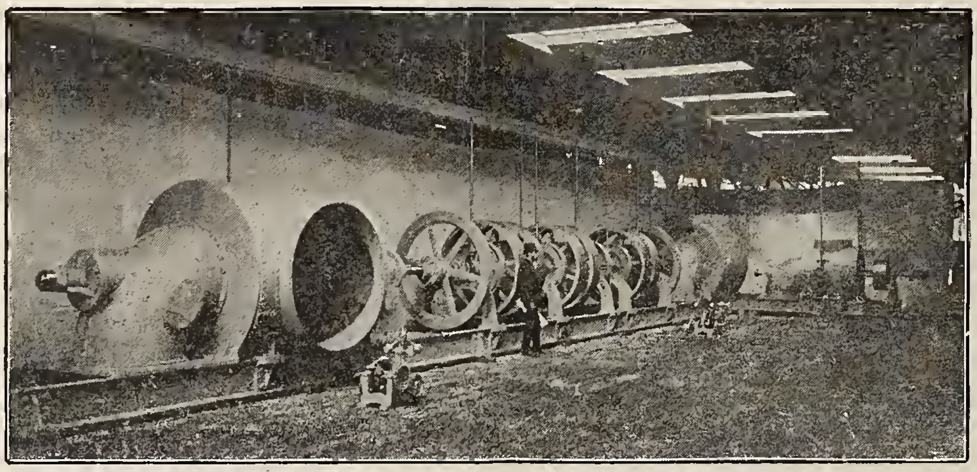
Even a slight fall is of immense value if only appreciated and applied. The power obtained is not due to the height from which it falls, nor to its volume, but to both; and a small body of water falling a great height is productive of as much power as the converse. In all sections of the country where fuel is scarce a waterfall is a most valuable addition; as it has always proven itself to be cheap, reliable and a readily available source of power. This must not be looked upon as an enthusiastic statement, because an examination into the conditions will readily determine the value of such a plant and save the investor from sinking his capital or at least investing it possibly in any equipment that would best be a steam plant instead. This of course simply refers to non-propitious circumstances, such as would require judgment and discretion in making a choice. A waterfall that freezes up in winter may prove to be more of a nuisance than anything else; they have been known to dry up and entirely disappear for certain periods of the year.

These, it would seem, are cases where power is tempting, but its use is expensive and its continuation doubtful. In all cases, however, where fuel is scarce, the utilization of a waterfall is the best and only thing to do. The type of wheel to be used for the best and most satisfactory application of this power to electric lighting is entirely determined by the nature of the falls. As a rule the only type considered is the turbine. The over-shot, under-shot and breast-wheel being practically out of date. A turbine may act either on a horizontal or vertical axis. There are three classes of wheels: parallel flow, outward flow and inward flow turbines. In the first the water flows in a direction parallel to the axis; in the second, it enters and radiates in a direction at right angles to the axis; and in the third, the water enters at the outer surface, leaving through the centre.

Turbines may work completely submerged or only partially so. The result of completely immersing them is a very perceptible lack of efficiency. The efficiency of turbines in general is very high, being at least 80 per cent. The data on the basis of which a wheel is put in should be carefully gathered; finding the average flow of water, the fall in feet and the volume passing. Although horizontal turbines are very convenient and often installed when possible, the vertical turbine is used when the fall is very great.

The Pelton wheel has come into use for very great heads of water. Out West in the mining districts the fall may be from fifty to over a hundred feet in height. Strange to say the efficiency of this wheel is as high as the turbine, and its strong construction enables it to stand the tremendous impact of a powerful stream. As part of the equipment of a power-transmission plant it seems to be succeeding excellently.

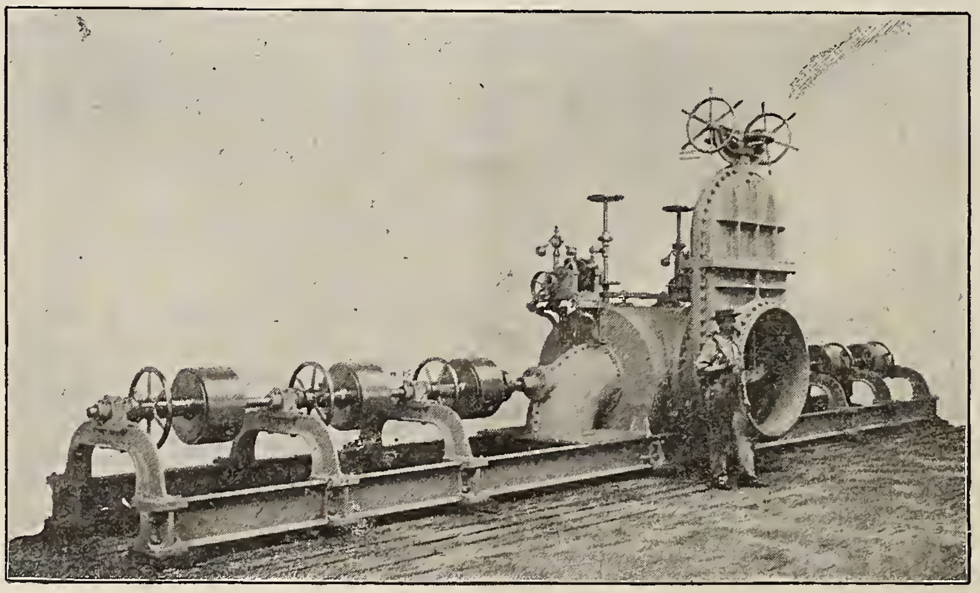
It is not always the best policy to put in machinery when the real thing to use is in doubt. Because water-power plants are not ideal unless provision is made for a possible lapse in the supply or a serious accident of some kind or other that might cut off the power entirely. The matter thus assumes a form which in a somewhat similar case was answered by the professor of a well known college most satisfactorily. He was asked his opinion regarding an automatic device which required the attention of a man to run it. "I would dispense with the device and keep the man." Thus it is with a water-power plant requiring too expensive an equipment for its continued operation. The saving would be imaginary and the inconvenience most evident.



TURBINE PLANT.

The control of a water-power plant is mainly due to the use of a governor. One of the greatest sources of trouble seems to be the difficulty of exercising the proper command over the speed and power. A turbine is but a small thing in itself in proportion to the power it gives, but it would be almost dangerous to employ it without something to reduce the power at times. A water-power governor is not influenced by a slight change; it is not susceptible to any but great reductions in supply, and therefore, by its insensitive action, becomes unreliable.

A speed regulator may be used to control the dynamo, the type called the Foote speed-regulator being considered the best. The difficulty with a water-wheel governor is that the gates do not act freely because of the heavy mass of water running by. In a plant supposed to supply a constant potential a governor is a necessity of no small consequence in any case, and its absence may eventually ruin not only the plant but the trade itself.



TURBINE AND SHAFTING.

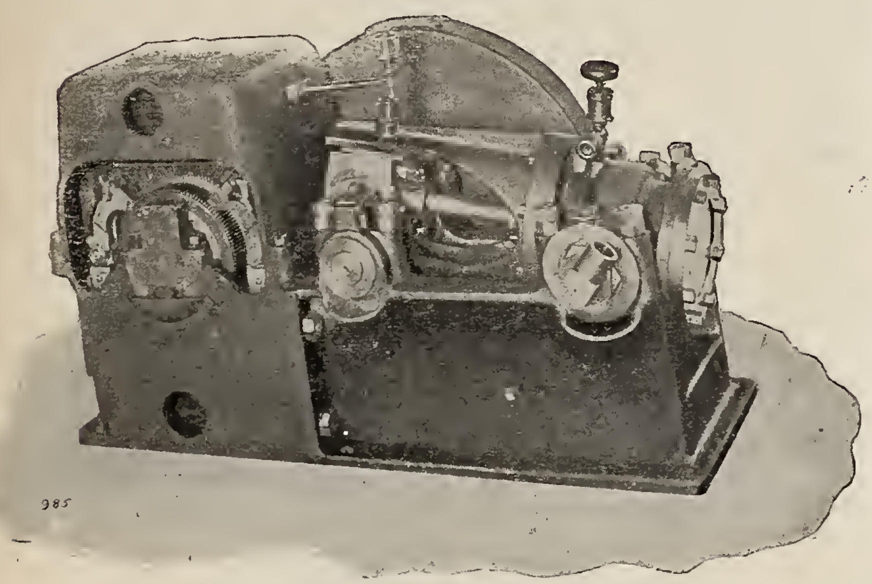
The simplicity of a water-power plant has always made it favorable to capitalists because this ideal method is much less expensive, if it can be run on economical principles, than any other known for cheap light and power.

PRINCIPLES OF DYNAMO DESIGN

BY

Newton Harrison E.E.

(*Continued from page* 187.)



AN ELECTRIC AIR COMPRESSOR.

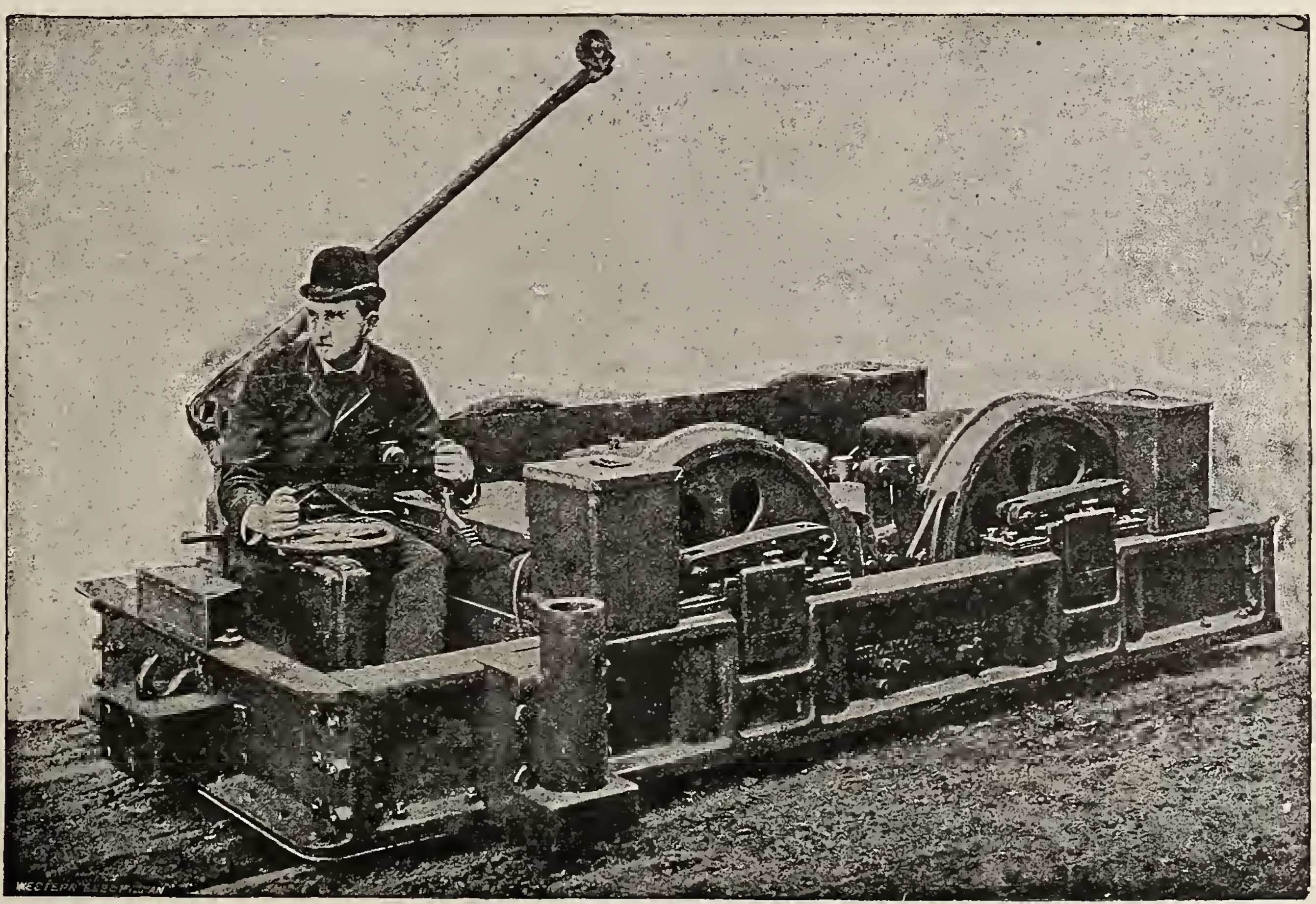
At times the coupler between engine and dynamo has a conical fit, so as to cause an easier and more adjustable contact between the two halves. The base plate, upon which both dynamo and engine rest, is prepared in the shop, so that none but the slightest changes are necessary in order to make a perfect fit. When both are mounted in a complete manner the plant cannot be heard running. The insulating flange has been dropped by the largest companies, although the tradition still exists and practice itself denotes that it has not been forgotten. At Buda-Pesth direct-connected machines were used in early days. The heaviest alternating current dynamos were used there, a large fly-wheel being the revolving field or armature of the machine.

Miscellaneous Applications.—The generator of railway practice is a 500-volt multipolar dynamo. It probably represents a type of machine whose special work far surpasses, in its heaviness and suddenness of application, any that is known. The requirements of ordinary electric railway practice are such that none but the most solid machinery can stand the wear and tear that is daily experienced.

The generators used are compound wound; the load, as shown by cards taken from the station, varying from zero to four hundred and fifty amperes in an instant. The strain on the engine and dynamo can be faintly imagined and the drop in the line approximated. The call upon the generators of incandescent light stations is never as severe as that. Frequently the engine is worn out, if of the high speed type, in answering to this sudden load. The motors on the cars express in miniature the same conditions. The car may be suddenly started, or when climbing hills the same heavy strain may be experienced. Railway generators and motors are now designed with the proper regard for such emergencies. The motors are built in a solid, substantial manner, which practically enables them to resist the wear and tear to a degree that is truly admirable. Of all branches of designing, perhaps, the one which calls for the most ingenuity on the part of the engineer is a generator whose pressure is of fairly normal value and whose armature resists the invisible blows so frequently given. While generators for electric lighting are subject to a gradually increasing or decreasing load, they do not differ very materially from those used in railway work. The permeability of the iron in one case is constant to within a few per cent. In the other case it is likely to vary between very wide limits, in order to meet the conditions of practice and vary the potential according to the load. The armature reaction, being likely to overpower the field, must be controlled automatically by the series-winding.

At one time shunt motors were applied to railroad work, but they proved unsuccessful. The speed of a shunt machine is capable of variation by the use of a rheostat in series with the field. A series motor which has been generally adopted for traction purposes is controlled by varying the field connections directly. This is valuable in allowing the torque to increase with the load.

Generators are, as a rule, direct-connected, except in cases where the distribution of power is made so as to comprise a great many units instead of only one or possibly two. Belt driving is then employed. A system of rope transmission has been tried, but its use is limited



MINING TRUCK.

and at present somewhat unpopular. The railway generator at present represents one of the best designed dynamos we have from the standpoints just outlined. Were the saturation of such a machine pushed very far its regulation would lack speed, the iron changing too slowly to secure the desired end.

In all machines in which a heavy load must be instantly and effectively met a wide range of magnetization is absolutely necessary.

Mining.—For a variety of purposes to which but brief reference can be made the dynamo is now generally used. Many of its applications are unique in the extreme and meet with difficulties at one time thought unsurmountable. The use of electricity in mines, for lighting and power, has opened up a new field of industry.

The great salt mines of Russia, the copper mines of Michigan, the diamond fields of Africa, and the coal mines of Pennsylvania employ the dynamo for purposes of lighting and for the supplying of current to short single track roads in the immediate vicinity. The greater freedom from danger and the far excelling illumination make it the greatest and most valuable of all innovations in this especial department of labor.

There is every evidence to show that much of the growth of mining industries owes its development in more than one way to the use of the dynamo. To begin with, the greatest output of the copper mines supplies the electrical trade. The improvements of an electrical nature have increased its output, which in return is consumed by the self-same fraternity. The amount of work a man can do is increased and the general benefits accrue from all sides. For mining work, especially in coal mines, a well protected dynamo is essential. The dust arising from all sides is particularly dangerous, as its carbonaceous nature will effect grounds with the utmost rapidity, and by coating the machine hasten its speedy destruction.

Iron-clad machines are therefore the best for such purposes; lasting longest and proving in all cases most satisfactory.

(*To be Continued.*)

Is the Corona of the Sun an Electrcial Phenomenon?

(*Continued from Page* 159.)

III. PHENOMENA INDICATING A TRANSLATIONAL MOTION OF THE GAS.

An interesting phenomenon was observed in the experiments with bulbs, when the vacuum was diminished by turning quickly the stop-cock several times around. The vacuum pressure was about 20 mm. The induction coil had to be strained considerably to force a discharge through the long glass tube. The discharge looked like a luminous jet shooting from the tube into the bulbs, and in its path around the corners it seemed to strike against the necks of the bulbs at two points, from which points it was reflected and glided along the surface towards the points below the necks. Inside of the bulbs the jet oscillated rapidly; it was also split up in several parts, each part consisting of numerous more or less intense streamers. A slight modification in the curvature of the necks modified the general outline of the luminous jet without changing its general character. With the increase of the gas pressure the phosphorescence appeared and seemed to be strongest at the necks. It was very strong in the tube leading to the stop-cock, although this tube was entirely free from the discharge proper. The height to which the phosphorescence rose in this tube increased with the current. Every slight variation in the current strength caused a simultaneous variation in the height of the phosphorescent column in the central connecting tube. (When the discharge ceased there was a strong phosphorescent afterglow all along the long tube). A similar behavior on the part of the phosphorescent gas which I observed in the experiment, described in *Am. Jour. of Science*, April, 1892, leads to the conclusion that the phosphorescent gas must have a translational motion, due to its being ejected from the path of the discharge proper. This strengthened my belief in a translational motion of the gas along the path of the discharge proper, which belief was due to the phenomena in the experiment just described. It was also strengthened by the phenomenon observed in the experiment described by me in the paper cited above, the phenomenon namely, that a discharge streamer made to curve way out (by the repulsive action of another parallel streamer), so as to strike against the walls of the vacuum jar will rebound from this wall just as a curved jet of water would if it struck against a rigid surface. In another experiment with an apparatus like the one described in the above paper, a thin rectangular sheet of mica was suspended between and parallel to two discharge streamers, and it was found that it prevented their action, which I described in that paper, but it was made to swing back and forth as if acted upon by a wind coming from the path of the discharges. This action was hardly perceptible in high vacua, but increased quite considerably with the increase of gas pressure. It may, however, be due to a great variety of causes, like peculiar distribution of pressures due to a peculiar distribution temperature; so-called apparent (in my case continually varying) electrostatic charge over the surface of the mica, etc.

IV. ON CORONOIDAL DISCHARGES.

Wishing to perform additional experiments which could throw some more light on this particular feature of discharge I constructed the following apparatus. A large glass bulb was coated with tinfoil along those parts of its external surface which would approximately correspond to its temperate zones, its neck being one of the poles. This tinfoil coating had a wire attached to it by means of which it could be connected to the pole of the induction coil, and serve as an electrode of the bulb. The other electrode was a brass sphere attached to a brass rod. This brass rod was surrounded by a glass tube, and the space between the two was filled with sealing-wax. In this arrangement the pressure could be varied between very wide limits (up to about 100 mm.), without running the risk of refusal on the part of the induction coil to force a discharge through. A camera was placed in front of the bulb and the discharges photographed. Figs. 1, 2, 3, 4, 5, 6,* are photographs of the discharges obtained in this manner, but in various degrees of rarefication.

I shall discuss the discharge given in Fig. 6 first. In this case the vacuum was very poor (about 60 mm. pressure). The discharge started in the form of four large streamers, together with a very large number of short luminous jets which were more or less uniformly distributed over the sphere. In consequence of these jets the appearance of the sphere reminded one very much of the granular structure of the sun's disk as revealed by Rutherfurd's, Janssen's and Vogel's photographs of the sun. Very luminous spots appeared from time to time at several points of the surface, which reminded one very much of the sun's faculæ. Both the jets and the large streamers rotated rapidly. This rotation is indicated very plainly in the photograph; for the number of streamers in each wing represents the number of maxima in the alternating discharge during the time of the exposure, which was a small fraction of a second. The thickest streamers indicate the place where the discharge started. It is evident that the streamers were distributed nearly systematically over the sphere at the start of the discharge; and that then one-half of them were gradually and almost uniformly displaced in the direction of the motion of the hands of a watch, the other half in the opposite direction. The peculiar curvature of some of these streamers indicates the presence of two kinds of motion—one a translational along the prolongation of the radii of the small sphere, and the other a rotational. It was this rotational motion which led me to assume that there must be some sort of repulsive action between the streamers of a vacuum discharge.

* See plate at beginning of this article.

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CONTENTS.

THE ATLANTIC CABLE.

A game of chess between opponents playing from continent to continent excites at present no surprise. A signal hurrying across the Atlantic is received with the utmost nonchalance. Neither the distance it has travelled nor the frightful abyss it has crossed excites a moment's consideration. Like the man whose system is inured to drugs, wonders no longer affect us—we pass amongst them unconscious of their existence. When Cyrus Field and Lord Kelvin, when Peter Cooper and the illustrious assemblage in which he moved promulgated the idea of laying an Atlantic cable, it was looked upon as a gigantic hoax. Opinions were rife on the subject and it was impossible to foresee the outcome of this great enterprise.

It is eighty-five years ago since Soemmering, in 1811, invented his telegraph which suggested the means at present employed.

When one hundred years have passed will the change be still more striking? There is every indication at present that we shall not only signal through the ocean's depths but speak.

It is possible that many do not know the cause of retardation in a cable, which prevents it from carrying more than a few impulses a minute. The capacity of the cable creates this difficulty. If the active core could be surrounded by a material which prevented induction, long distance telephony would extend to Europe; it could send its lines around the earth with success.

By investigating the cause of all difficulties in ocean cabling the mind is prepared to consider what remedies would be required for the elimination of the same in telephonic work.

Their entire suppression is necessary if a telephone is to be used, speech being impossible with a conductor like the cable, that absorbs and entirely retains the electrical impulse.

To be able to speak to England would necessitate the choice of at least two things—a new transmitter or a new cable; the new transmitter to overcome the influences at work at present, preventing the transmission of even thirty vibrations a second, a rate at which Helmholtz claims sound just becomes perceptible. Possibly the difficulty may be removed by changing the cable. It is a well-known principle that is to be referred to. If the effects of a capacity are to be removed, a self-induction distributed uniformly according to a given computation will completely annul its effects. A cable built on this principle would allow a whisper to be heard in a receiver three thousand miles away.

This, we think, would allow the cable to become at once the speaking-tube of Europe.

STREET RAILWAYS.

In 1879 Siemens & Halske, of Germany, erected an electric road in Berlin. It proved a commercial success and opened up a new field of enterprise. As early as 1835 electric railways were considered practicable—a model built by Thomas Davenport at that date being still intact. It required a Vermont blacksmith to show the world this germ of future development. Railways for cities have been chosen in many cases by popular opinion. The cable, trolley and conduit systems are at present side by side in our own city. It seems that in spite of the popularity of the trolley and cable both will surely go. There will not be a lingering delay but a complete and radical upheaval, an entire departure from the old practice. Side by side these systems are each receiving a critical test. It remains for a decision to be made, based upon facts and figures, to sweep away all delusions. Such delusions that have at times blinded the discernment of our most acute-minded men. There is a chance for a new power to be called into action It is called by psychologists "the power of discrimination."

Its absence has always called forth remark—its presence frequently contempt. We are prepared to await the verdict of capitalists; to hear them fondly call out the cost of each car mile and thus reach the bed rock of facts.

When the cable and trolley have bidden us adieu there will still be two competitors left. The adherents to the so-called slotted conduits, brought into notice by Siemens & Halske—also Bentley & Knight of this country—and the automatic block or composite systems of the Wilcox Bros. and Lundell. The expense of these two systems will be a matter of careful consideration. Their future development will be solely determined by the dependence to be placed upon each respectively.

Not for a day or month will such considerations rule, but for the times when snow is heaped upon the tracks. when the rain has flooded the sewers; in fact, when all the elements of nature seem to have conspired together to disturb its hitherto successful operation. The road which "then pursues the even tenor of its way" will rejoice in a largeness that would shame the combined bank accounts of our most ancient friends, Crœsus and King Midas.

TELEGRAPH AND TELEPHONE LINES.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

The Line.—The consideration of a line from certain standpoints makes the subject one of deep interest and importance to the earnest reader. A line is merely a conductor supported at frequent intervals by insulators. Its utility and efficiency depends entirely upon the excellence of these supports and its own conductivity. The material of the line merits the closest attention, and its resistance as compared with that of its supports provides a means of estimating the loss or gain by any specific change in either. Usually conductors are of either iron or copper for line work.

The insulators are usually of glass, although those used indoors are made of hard rubber. To give an idea of the extraordinary difference between a good conductor and an insulator a comparison made by Fleeming Jenkin might be recalled.

"The difference between a copper conductor and a gutta-percha insulator is about as great as the difference between the velocity of light and that of a body moving through one foot in 6,700 years." The following table gives a list of conductors in the order of their conducting power, also showing the decreasing insulating property of various materials:

Conductors.	Insulators.
Silver	Air
Copper	Glass
Zinc	Hard Rubber
Platinum	Shellac
Iron	Gutta-percha
Carbon	India Rubber
Acids	Porcelain.
Salt Solutions	Earth
Water	Ice
Wood (damp)	Oxides

A copper conductor is used as a basis for estimating the resistance of wires of other metals. In a table given by Franklin Leonard Pope a means of arriving at this fact by a simple calculation is shown:

For brass,	multiply copper resistance by				4.5
" German silver,	"	"	"	"	12.9
" iron,	"	"	"	"	5 9
" platinoid,	"	"	"	"	19.5
" platinum,	"	"	"	"	14 8

This valuable little table will prove very useful when wires of the same length and diameter are compared, and equally so should their diameters vary, because two wires of the same material and same length have a resistance inversely proportional to the square of their diameters. For such purposes a mil foot of each would show the desired relationship in an easy manner. A mil foot is one foot of the metal .001 of an inch in diameter.

The line in telegraphic practice is gradually being changed from galvanized iron wire to copper. This is an advantage in every respect, but means a heavy expense to the company. The leaks that occur from the line to the earth, due to the following—

Grounds,
Crosses,
Poor insulation,

are at times very bad, draining the system of its current and thereby destroying its effectiveness to a great extent.

The insulators may be covered with a film of rain water, the poles may decay and get soaked, and floating dust settling upon both insulator and line may provide a path to earth. In comparison with pure copper, clean rain water has 40,653,723 times the resistance. When mixed with foreign matter its conductivity greatly increases.

The earth in telegraphy acts as a return circuit; the extremities of the line being grounded by means of a large plate, either of copper or iron. This is set into the earth and from it the signals either extend forward or return through the instruments at each end. The earth, if very dry or sandy, will be a poor return circuit and the line suffer in consesquence; therefore moist earth is the best material in which to ground the line. In a city the gas or water-pipe system is sufficient.

The resistance of an earth return is practically negligible, and is therefore lightly considered when tests are made.

Its specific resistance is very high, but the enormous cross section is ample enough to secure an almost complete reduction in resistance.

The ground plates, if made of copper, are about $\frac{1}{16}$-inch thick and about 4x4-feet in area. A galvanized iron plate is very much cheaper and just as serviceable. Contact is made with the connecting wire by soldering it, and the joint is protected by a non-corrosive substance from electrolysis and chemical action. If the soil is very dry a pit should be dug and the plate laid in it, surrounded by coke or charcoal, or other refuse equally applicable. A granitic district would probably develop some such a peculiarity.

Posts.—The poles will last long if their ends are creosoted or soaked in some silicic or protecting compound. In moist soil the decay quickly commences, and when aided by the burrowing of insects rapidly weakens the structure. A pole when wet falls quite considerably in resistance. As a rule the comparison is made between the resistance of the pole and that of the insulator and arm.

$$\frac{\text{resistance of pole}}{\text{resistance of arm} + \text{resistance of insulator.}}$$

This expresses the ratio between the two in a simple manner.

Cross-arms—When the cross-arms of a pole are dry the resistance is about 100,000 ohms, but when wet this may fall as low as 4,000 ohms.

If left exposed to the air without even a coat of paint, the fall in resistance is very noticeable. The least resistance a cross-arm will have is about 1,000 ohms, that has not been absolutely soaked in water.

Treating the poles and arms to a preparation that does not absorb moisture would enhance the excellence of them as insulators quite considerably. The supporting power of a pole and its resistance in ohms are two entirely different and unproportionate qualifications, though they may bear a slight relation to each other.

Insulators—The common form of insulator for line use is the single petticoat glass insulator so familiar to all. This is not a very excellent device for the purpose, as it is hydroscopic and brittle; but its cheapness and convenience make it a most popular article of use. The floating dust and begriming smoke soon impair their insulating property in a city or its suburbs. The maximum resistance per mile is about 60,000 to 100,000 ohms, depending upon the humidity of the air and their cleanliness. This may fall as low as 25,000 ohms per mile, if damp and dirty.

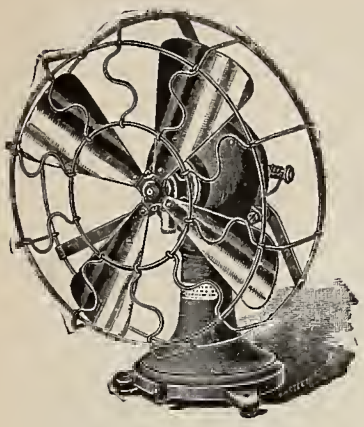
Varley, in his report to the Western Union Telegraph Co. states that the cleansing of insulators almost triples their resistance.

The improvement of a line depends greatly upon the insulators used, German porcelain are about the best The glass insulator is about 5 megohms in resistance, while German porcelain insulators are over 15 and sometimes 20 megohms in resistance (1 megohm = 1,000,000 ohms). It is generally cheaper to improve the insulation of the line than to use a copper line. It costs about four times as much to increase the conductivity by the use of copper as to use new insulators of high resistance.

The ratio between the conductivity of the line and that of the insulators is 1 : 10,000 with a No. 9 iron wire (Pope) of 15 ohms per mile, mounted on glass insulators of 4.5 megohms a piece, and 30 poles to the mile. This is generally about the average condition of a line, and any increase in this ratio means a gain in current.

(*To be Continued.*)

INTERIOR CONDUIT AND INSULATION COMPANY.

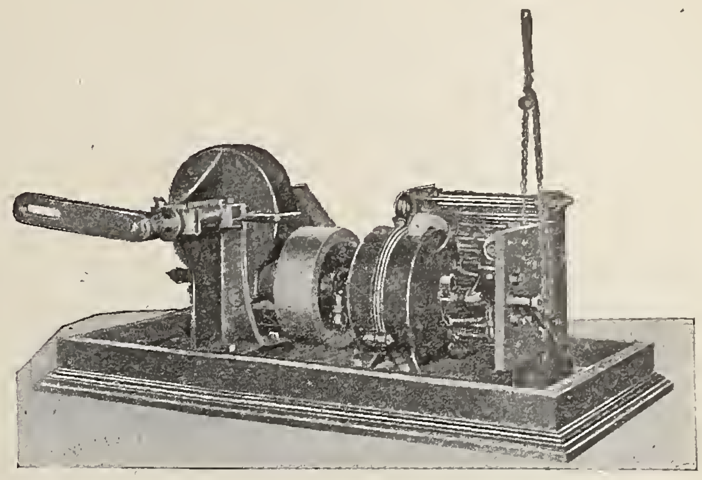


LUNDELL FAN MOTOR.

The many interesting exhibits at the coming electrical exposition will be equalled if not surpassed by that of the Interior Conduit and Insulation Co.

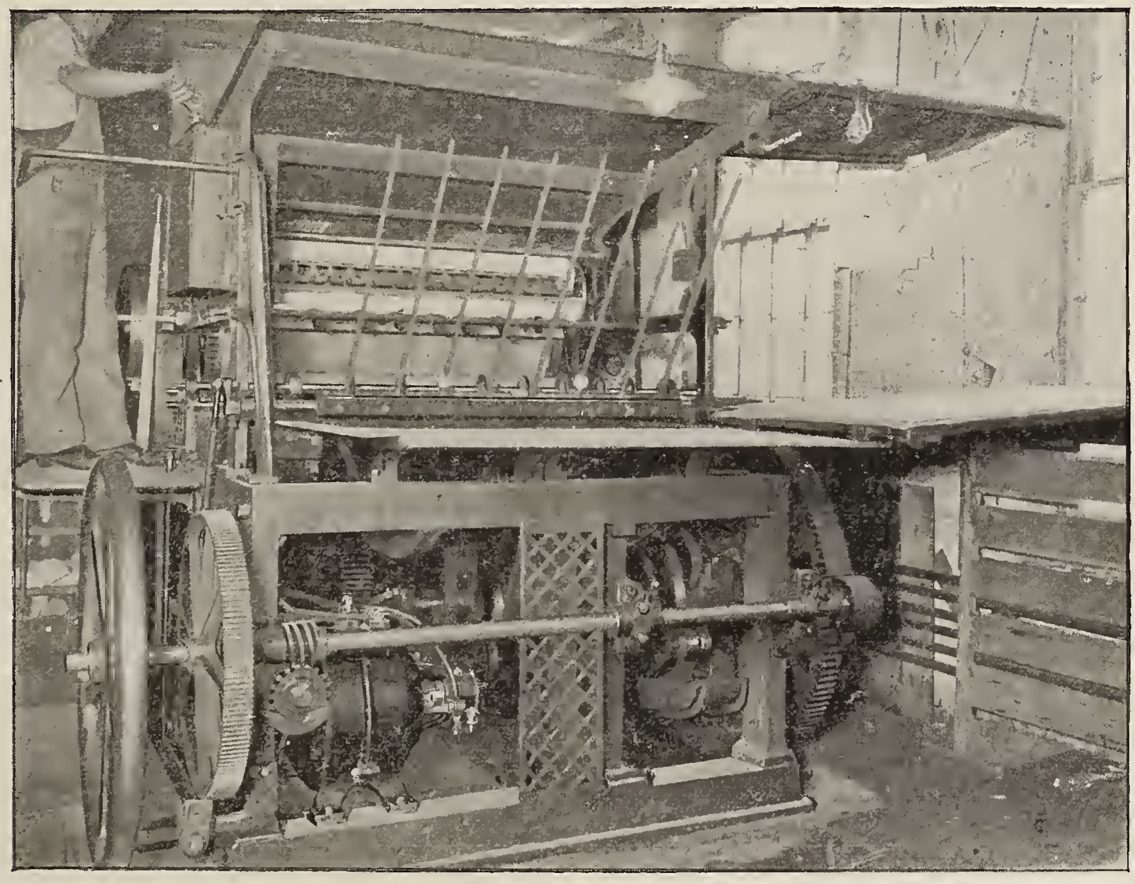
They have taken considerable space in the exposition hall and will show in operation a printing-press run by a direct-connected Lundell motor. Exhaust fan outfits of 60-in., 36-in. and 12-in. diameter, and their excellent desk fan motors. Many of their most successful specialties will be seen there; such as ceiling fan motors, dental equipments, emery-wheel grinders, buffing machines and an organ-blowing attachment. The latter outfit will be actuating a Mason & Hamlin organ, which will be played each evening.

There is no doubt that the Interior Conduit and Insulation Co. will show some of the most finely finished work of the



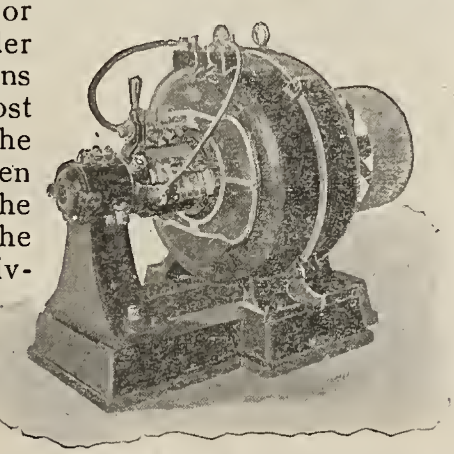
LUNDELL ORGAN BLOWING ATTACHMENT.

fair. Those that visit the exposition will not doubt this statement when they hear that Messrs. D. C. Durland,



PRINTING PRESS RUN BY A LUNDELL MOTOR.

These outfits are noiseless and the bellows of the organ is always under absolute control. They can be adapted to reed organs and large or small pipe organs. Under average playing conditions the motor maintains almost a constant speed, keeping the bellows nearly full. When the entire resources of the organ are drawn upon the motor quickly speeds up, giving the maximum supply of wind. If the player suddenly stops or plays pianissimo, the motor immediately responds, and its speed is decreased, so that the bellows is not over-blown, the outfit completely controlling the wind supply under any and all conditions.



LUNDELL MOTOR.

They will also exhibit a complete system of plain, brass-armored and iron-armored insulating conduits, as well as a complete underground conduit system. An illuminated sign, 30 feet in length, will be a feature of their exhibit.

Geo. H. Kimber and E. B. Kittle will preside over this exhibit and explain to friends the various novelties.

Interesting Facts in Science.

Nickel Steel.—Nickel steel has as yet been little used for anything but war material; but its physical properties are such that could it be obtained at a reasonable price, there is little doubt that it would be very largely adopted in general engineering work. Two samples recently tested for the United States Government showed a tensile strength in the one case of 36.2 tons per square inch, and in the other 34 tons per square inch. The elongations were respectively 18.25 and 17.87 per cent. on eight inches. A piece of the metal 1¼ inches thick was forged cold to one-half inch without fracture.—*Engineering*.

Thirty-six Million Miles in Forty Minutes.—When Mars is nearest to the earth its distance is no less than 36,000,000 miles. But if we set our speed to match that of an electric impulse flying through the Atlantic cable—say 15,000 miles per second—we should be there in just forty minutes.

Perpetual Motion.—One hundred and twenty years ago, in 1775, the Paris Academy of Science withdrew its standing reward of 500,000 francs which had been offered for a "perpetual motion machine." It was plainly stipulated in the offer that the machine should be "self-active," so much so, at least, that when once set in motion it shall continue to move without the aid of external forces and without the loss of momentum until its parts are worn out. During the years that the above reward was the standing offer thousands of men became insane over the problem. At last, at the date given, the impossibility of constructing such a machine having been demonstrated, the offer was formally withdrawn. No government or society of standing now offers a reward for such a machine.

THE EVOLUTION OF THE STOCK-TICKER.

An exhibit that is sure to arrest the attention of the numerous visitors to the exposition will be that which shows a stock-ticker system in full working operation. To watch the tape unroll with the curt little signs on it is one thing, but to see how the information that means so much to the financial world is gathered and put on the circuits, is another matter of interest to everybody. The development of the modern stock-ticker system, so strikingly American, is the result of much ingenuity and enterprise, and has brought many brilliant electricians to the front.

With the object of assisting to a better understanding of the subject, the executive of the Gold and Stock Telegraph Company has generously authorized its superintendent and electrician, Mr. Geo. Scott, to place at the disposal of the Exposition management a number of old instruments that will be useful in showing how the system as it exists today has been worked out to its present stage of efficiency and celerity. Mr. Edison and others are also contributing apparatus of this nature, rendering the display one of unusual value, as such electrical machinery has never been brought together before in this instructive manner.

PERSONAL.

The Standard Underground Cable Company has recently made a number of important changes in the personnel of its home office at Pittsburgh, in order the better to facilitate its already large and constantly increasing business.

Mr. P. H. W. Smith, who was formerly Superintendent of Construction for the Western Sales Department of this Company and more recently assistant to Mr. J. W. Marsh, the vice-president and general manager of the company, has now been appoited assistant general manager of the company. Mr. Smith's training in electrical matters was received at Lehigh University, of which he is a graduate. He has been actively connected with the Standard Underground Cable Company for a number of years in construction and sales departments, and the advancement is well merited and will be appreciated by his many friends.

Mr. F. S. Viele, formerly of the Buffalo Railway Company, but for several years past Superintendent of Construction for the Western Sales department, and temporarily in charge of the latter, has been transferred to Pittsburgh as manager of the Conduit and General Construction departments. In addition to the general construction work, Mr. Viele will have under his immediate charge and supervision the Conduit Sales department and Rubber Sales department. Mr. Viele is a graduate of the Massachusetts Institute of Technology and Electrical Engineering, and his recognized ability as a trained expert in matters pertaining to insulated wires and cables, makes him a valuable man to the company, and his many friends will be pleased to learn of his promotion.

Johann Jordan, of the noted firm of Schieff, Jordan & Co, Vienna, is in town. They are makers of ship carbons. Their pencil carbons for arc lamps are selling extremely well. The Standard Paint Co., 81–83 John street, New York, are their North American agents.

ROENTGEN RAYS.

The Characteristics of Ether.—It seems to be an incompressible body of a jelly-like nature. Its frictionless quality and property of inertia constitutes at present the best conception we have of its real nature. To act as transmitter of motion seems to be its sole function. The vibrations within glass are transmitted at the rate of half a million centimeters per second; but the ether within it transmits them 40,000 times quicker—at twenty thousand centimeters per second.—*Extracts, work by Oliver Lodge.*

What is a Magnet?—To make a magnet, we only need a current of electricity flowing round and round in a whirl. A vortex or whirlpool of electricity is, in fact, a magnet; and *vice versa.* These whirls have the power of directing and attracting other previously existing whirls according to certain laws, called the laws of magnetism. —*Oliver Lodge.*

Photographing Rose Tints.—It is reported that Doctor Selle, of Brandenburg, has perfected a method of photgraphing in colors, which was recently exhibited before the Berlin Photographic Club. Dr. Selle bases his process on the three primary colors of Helmholz—that is, three colors which, combined together, must produce a pure white. The primary colors which he uses are crimson, pale yellow, and a peculiar blue-green. He takes three photographs of an object; the first with all except the red rays cut off, the second under yellow light, and the third with blue-green. These photographic positives are taken upon exceedingly thin films, which are stained each with its aniline color. The three films are pasted over each other, and the result is an exact reproductton of the colors of nature in the original object. The results which Dr. Selle exhibited are said to be wonderful. Dark red roses photographed from nature had even the rich, peculiar violet hue which the artist with brush and palette despairs of reproducing. Photographs of butterflies and of peacock feathers astonished the spectators most of all. Photographs of paintings and of buildings and landscapes were equally true to nature. Dr. Selle has not yet succeeded satisfactorily with human portraits, though that, of course, is his ultimate ambition. The difficulty is to take three photographs in succession so quickly that the expression shall not change in the meantime. It is necessary, of course, to change the plate in the camera twice without the slighest movement on the part of the object to be photographed. This difficulty, however, is only a mechanical one, and it ought to be surmounted before long.

Lighter than Aluminum.—Better than Copper—The metal glucinum is attracting attention for electrical work. It is lighter than aluminum, has a greater conductivity than copper, and is less expansible and more durable than iron. It costs now about $18 per pound, but owing to its lightness a piece of a given size is 1-160th the price of a similar piece of platinum.

A New Test of Diamonds.—It is reported that Prof. William Lispenard Robb, of Trinity College, Hartford, Ct., has made X-ray pictures of a real and an imitation diamond. The genuine stone was transparent to the rays, while the artificial stone cast a solid opaque shadow.

Cut off from Mankind.—Prof. Janssen and his corps of assistants are now winter-bound in their observatory on the summit on Mont Blanc. They will remain there, cut off from mankind, until later in the spring. They keep in touch with the world by means of the telegraph.

NOTE.

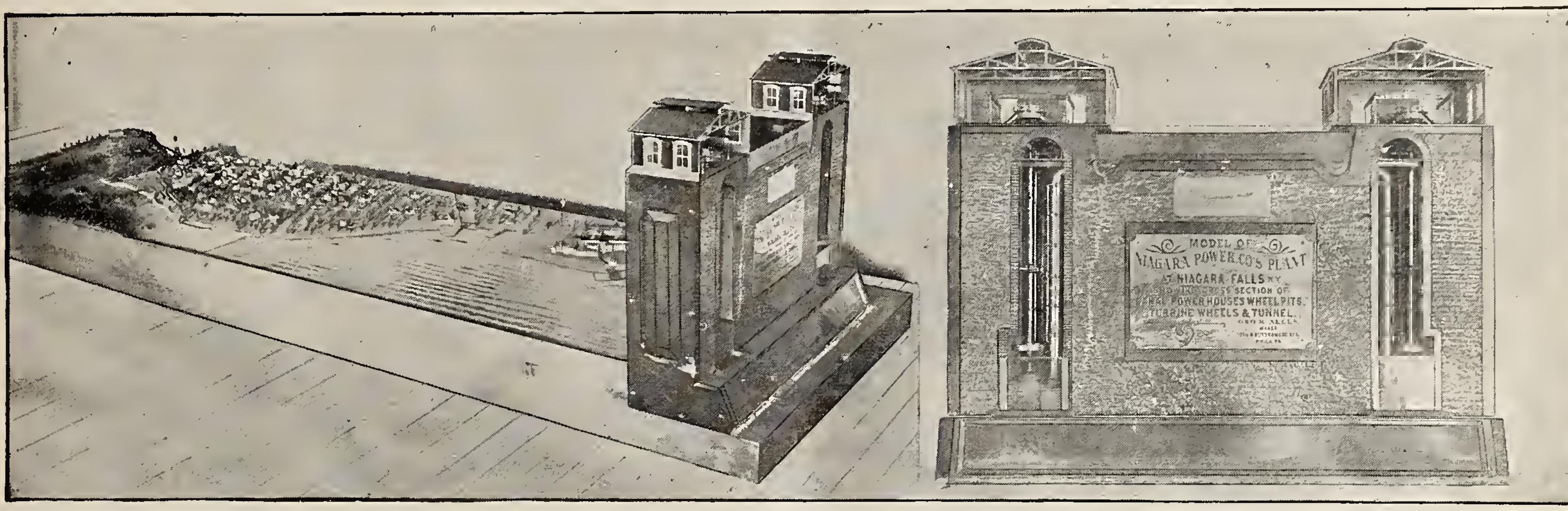
ELECTRICAL EXPOSITION NOTES.

New York, April 17, 1896.

Electrical Age World Building, City.

Gentlemen:—Enclosed please find items regarding the Electrical Exposition which may interest your readers.

Very truly yours,
Geo. F. Porter,
Secretary.



WORKING MODEL OF NIAGARA CONSTRUCTION COMPANY'S PLANT AT THE EXPOSITION.

National Electric Light Association,
136 Liberty Street,
New York, April 17, 1896.

Electrical Age, World Building, New York.

Gentlemen:—Arrangements have been made whereby delegates on the line of the Chicago and Alton road can use that road to Chicago and connect with the electrical special at that point for a fare and one-third, on the certificate plan. This will enable the St. Louis delegates to leave that city at 11:30 p. m., reaching Chicago at 8:30 the following morning, which will enable them to remain in the latter city until the time the electrical special leaves, namely, 5 p. m., Saturday, May 2.

Very truly yours,
C. O. Baker, Jr.,
Master of Transportation.

CONVENTION NOTES.

Electrical Age, World Building, City.

Gentlemen:—I am pleased to inform you that the Murray Hill Hotel, Forty-first street and Park avenue, has been selected as the hotel headquarters for delegates to our ninteenth convention, May 5, 6 and 7.

It is stipulated, however, by the hotel management that none of the guests make use of any part of the hotel for exhibition purposes or display any signs or placards in the halls or corridors.

The exposition to be held under the auspices of this association will open May 4, in the Industrial Building, two blocks from hotel headquarters.

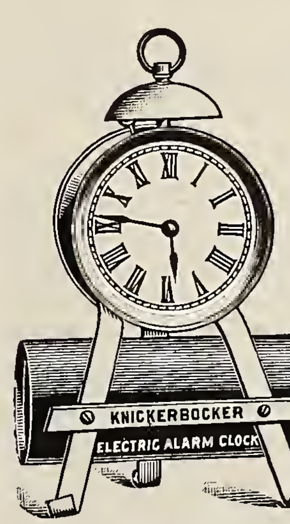
Respectfully,
Geo F. Porter,
Secretary.

STORING NIAGARA ENERGY FOR THE EXPOSITION.

THE announcement was made last week of the generous offer of the Western Union Telegraph Co. of two wires from Niagara, with which to bring current from the power plant there to run the model of the plant at the exposition. These wires will be available in the evening, and the question thus arose as to what should be done in the way of running the model the rest of the time during each day. Mr. A. S. Brown, the electrical engineer of the Western Union Telegraph Co., suggested that it would be a comparatively easy thing to ship a few storage batteries up to Niagara, charge them there and bring them down for the purpose. This simple but shrewd suggestion has been acted upon and the Electric Storage Battery Co., of Philadelphia, through Mr. Chas. Blisard, its representative in this city, has placed at the disposal of the exposition all the batteries that may be needed, with the permission that this stored Niagara energy can also be turned loose on any other exhibit at will.

There will thus be exhibited the energy of Niagara in a "live" form, coming over the wires in the shape of an alternating-phase current to drive the model by a phase motor; and the stored Niagara energy, which will, of course, be applied to a direct-current motor, which will also run the model part of the time. A more interesting illustration of the flexibility of electrical power transmission than this could hardly be desired, as it practically embraces the whole field of modern methods and appliances.

HOW TO WAKE UP EARLY.



NO. 1.

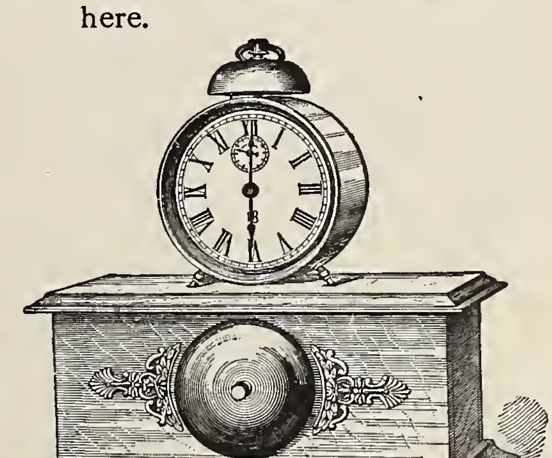
Get an electric-alarm clock, set it to the time at which you wish to be disturbed from your slumber and the clock will do the rest. Frequently the clock is overwhelmed with anathemas from the disturbed one, but it is simply doing its duty and does not discriminate between those who are really glad to get up and those who are not.

If you want an alarm clock that will wake you up early and one that will always be on time in the performance of its duty, none are better than those shown here.

They are neat and useful outfits; the clocks have fine movements and keep excellent time.

All parts are heavily nickeled. Sent by express on receipt of price, $2.50 each.

W. Mueller, 63 Park Row, New York, makes these clocks.



NO. 2.

TELEPHONE CHARGES.

COFFEY'S BILL TO REGULATE THEM KILLED IN THE SENATE.

Albany, April 14.—The Senate Committee on Miscellaneous Corporations this morning reported adversely Senator Coffey's bill regulating telephone charges.

Senator Coffey moved to disagree with the report, saying that there were no appearances against the bill.

"The bill comes from telephone subscribers," he said. "The rates in Brooklyn are exorbitant. I cannot see what operated to bring an adverse report. The companies did not appear. They must have had a guarantee either inside or outside of the Legislature that their interests would be protected. I feel that I am justified in making that charge. I am surprised at the deep interest manifested in these corporations by Senators from up the State."

Senator Brush said it was time that some legislative action be taken toward regulating telephone charges.

"There should be restraint to the watering of stock," he said. "Dividends must be paid on the watered stock and the people are oppressed by charges in order to make the dividends. I suggest that an investigating committee be appointed to inquire into the capitalization of the big telephone companies."

Senator Malby defended the adverse report. He said that the gas, telephone and electric companies were always made the target of some one in the Legislature.

The motion to disagree was lost, 6 to 30, as follows:

Ayes—Messrs. Brackett, Brush, Coffey, Ford, Martin and McNulty—6.

Noes—Messrs. Ahearn, Brown, Burns, Cahoon, Coggeshall, C. Davis, Featherson, Foley, Harrison, Higbie, Johnson, Krum, Lamy, Lexow, Malby, Munzinger, Nussbaum, Parsons, Pavey, Raines, Seibert, Sheppard, Stewart, Stranahan, Sullivan, Tibbitts, White, Wieman, Wilcox and Wray—30.

This kills the bill.—*The Sun.*

McKeesport, Pa.—The streets of McKeesport are to be lighted by the electric system as soon as the necessary arrangements can be made.

INQUIRY COLUMN.

In this column we shall endeavor to answer all questions relating to the science of electricity that may arise in the minds of our subscribers.

(*Q.*)—Cost of Running a Motor.

Dear Sir:—What would be the cost of running a 30 or 35 H.-P. motor at an average of 15 H.-P for ten hours per day at 6 cents per H.-P. hour; also would it cost more to run a 35 H.-P. machine at an average of 15 H.-P. than a 15 H.-P. machine at the maximum capacity; or more to run both a 20 H. P. and a 15 H. P. at the same average than a 35 H.-P singly. J. P. R.

(*A.*)—At 6 cents per H.-P. hour a 35 H.-P. machine delivering 15 H.-P. would cost only 90 cents per hour at 100 per cent. efficiency. Assuming an efficiency of 80 per cent. at this load the expense would be $1.125 per hour, and for ten hours $11 25.

A 35 H.-P. machine loaded only to 15 horse would cost about the same to run as a 15 H.-P. machine loaded full, but there would be everything in favor of the 35 H. P. motor.

Both a 20 H. P. and a 15 H.-P. motor run at full load would cost more to operate that a 35 H -P. running under the same conditions.

(*Q*)—Two and Three-Phase Currents.

151 East 20th Street,
New York City, April 3, 1896.

To the Editor Electrical Age.

Sir:—Will you kindly tell me, in your "Answers to Inquiries" column, what are the correct points at which to tap the coils of a direct current four-pole machine in order to obtain a two-phase or three-phase current. I understand that this principle is followed in the rotary transformers for the Niagara Falls electric railways.

Yours truly,
J. E. Stone.

(*A*)—It is not practicable to tap a four-pole machine for a three-phase current. A two-phase current can be obtained by connecting at four equidistant points on the armature. This is done as follows: The commutator is enclosed by four rings which are insulated from it, but each successively touching or connecting to one segment which is 90 degrees from its neighbor.

The Thomson-Houston ball armature was capable of giving three successive impulses, and was therefore competent to supply a three-phase current. The curious armature winding and connections was responsible for this. As this was a two-pole machine, the same idea could be applied with further development to a four pole machine.

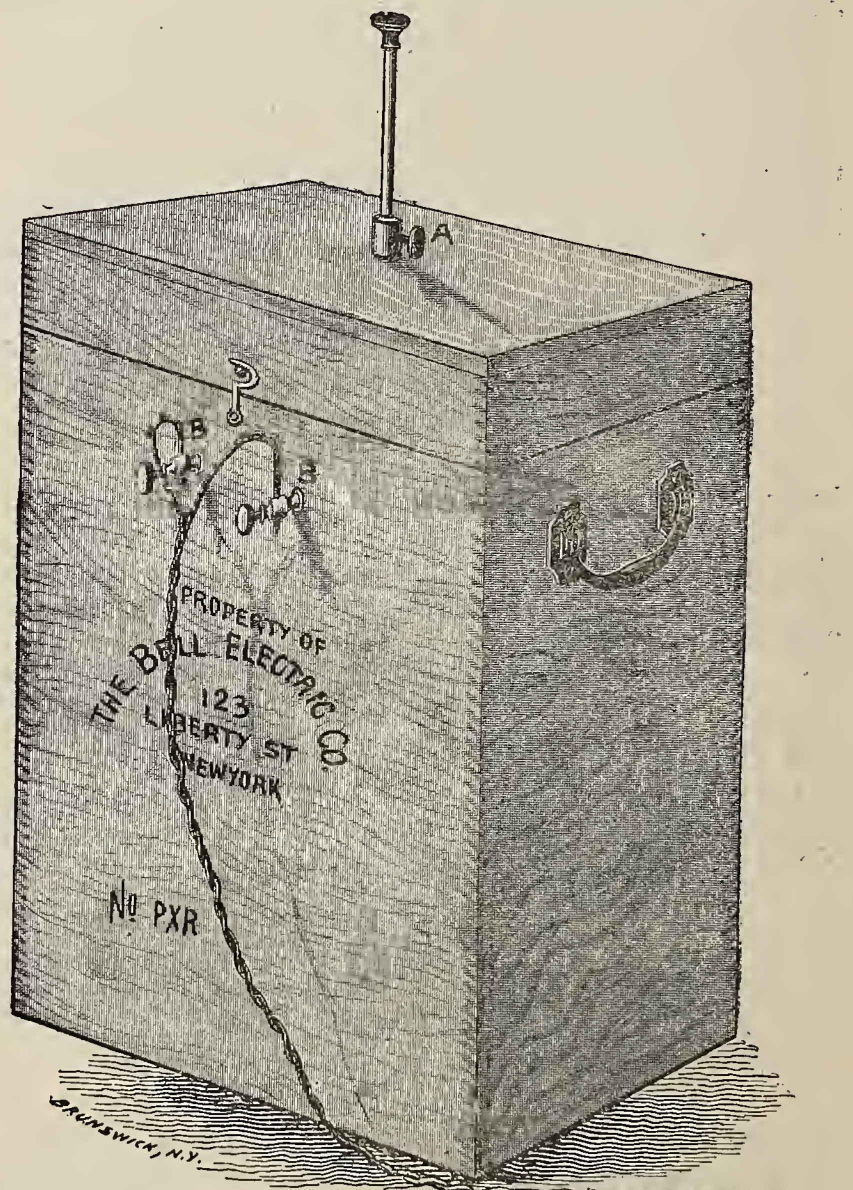
THE WONDERFUL EFFECTS OF HAIR-SINGEING BY ELECTRICITY.

How to make a Hair Translucent so as to see its Veins, Oils and Construction.—Why Baldness is so common among Men and so rare among Women.—The number of Hairs on a Head.

THE WONDERFUL BATTERY.

Hair singeing is unknown to most men, but has always been done by women with evidently good results.

The taper, which was in common use for the operation by barbers and hair-dressers, is uncertain in its work, often leaving uneven spots in the hair; its use, however, was tolerated by the public because of its undisputable results.



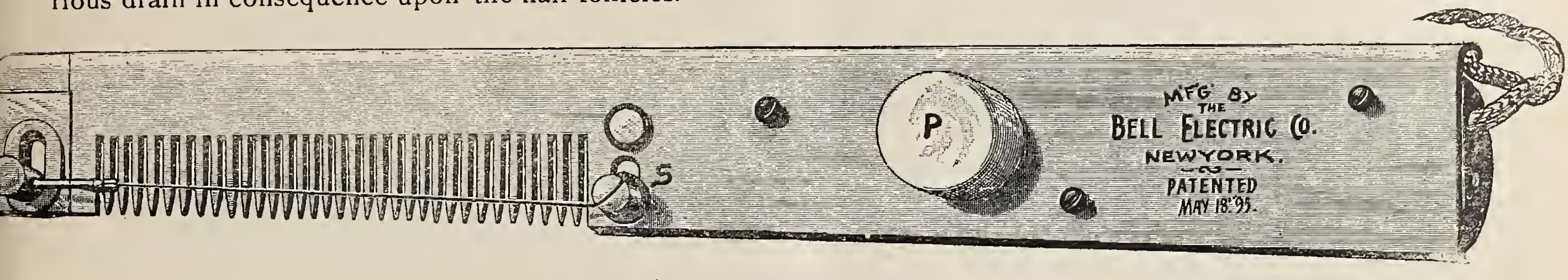
BATTERY FOR SINGEING COMB.

There appeared upon the market, last year, an improvement upon this old manner of singeing. This new electric process added the most wonderful and stimulating effects, which so materially improved the appearance of the hair and enchanced its growth, that the public generally are now demanding its use.

This apparatus consists of a comb of aluminum, as shown in cut over the teeth of which is stretched a composition wire; when the button is pressed the electricity passes through this wire, heating it to incandescence; the hair after being cut is simply combed with this electric singeing comb, and the end of every hair is cauterized, thus preventing the loss of the natural oil and the injurious drain in consequence upon the hair follicles.

The cutter wire of the electric singer is No. 26, B & S, and requires from six to ten amperes to heat it to its work. This battery lasts about one hundred ampere hours and is absolutely constant. Its internal resistance is wonderfully low. Any degree of heat is obtainable by simply raising or lowering the rod in the top of the box, by loosening the set screw A. The expense of keeping the battery up is astonishingly low. One cell of this battery is capable of fusing a No. 16 copper wire.

F. M. Bell.



ELECTRIC COMB.

The current of electricity penetrates the nerves and bulbs of the hair and stimulates their action; thus it may be seen why the scalp becomes so healthy and free from dandruff after its use.

Barbers have at all times advised singeing, but the old process required from ten to fifteen minutes, and in addition to its cost of twenty-five cents the work was unsatisfactory and uneven; but by the new electric process, the current of electricity being under control and the composition wire being always held in a straight line, it is impossible to burn the hair unevenly and the operation only requires thirty seconds, while the price charged is, of course, greatly reduced.

Under the microscope a hair which has been cut can easily be seen to bleed, and the effects of singeing it can be appreciated.

The electric process does not leave those unsightly burned ends which were so objectionable in the old process.

TO MAKE A HAIR TRANSLUCENT,

so that the veins, oil tubes and construction in detail may be seen, simply dip it into a mixture of

Spirits turpentine.................... one part,
Alcohol (95%)........................two parts.

By leaving a hair in this solution for two hours it becomes translucent, and by the aid of the microscope its entire structure may be seen.

The main source of baldness in men is due to the terrible and unnatural drain upon the hair nerves and follicles, caused by the constant cutting and the loss in consequence of the natural oil, and therefore makes the follicles generate five times as much oil and coloring matter as they would if they did not bleed; thus the cause of dandruff is seen, for the over-worked follicles draw all the oil from the scalp, which becomes dry and sheds off scales of dandruff. In proportion to their size, the oil tubes of the hair are larger than any artery in the body.

When the hair is singed by this electric process all bleeding is prevented and, at the same time, the stimulation received by the follicles from the electric current makes them vigorous and healthy and, in consequence, their action perfect.

The fact that 17 per cent. of the male population in America are bald, while only one-fifth of one per cent. of the female, is the most conclusive argument that haircutting is injurious unless the bleeding is checked by singeing.

THE BATTERY

used on this outfit is causing considerable interest among electricians.

It consists of two cells, size, 2½x9½x6¾ inches. These two cells are in a wooden case 8x6x13 inches.

The battery gives off no fumes, has no creeping salts, gives five volts (2½ volts per cell) and its amperage is wonderful.

Mrs. Long, of Flushing, became affected with neuritis of the arm last year.

Last week the doctors decided to use the X rays in the hope of finding out the cause of the malady. Mrs. Long went over to Columbia College and Prof. Pupin made a ten-minute exposure.

"It's the best I've taken yet," said the scientist enthusiastically.

Yesterday the photograph was sent to specialists in the hope that they might trace out the disease. The print shows the bones wonderfully clear and several dark spots that may prove to be the cause of all the trouble.

Marston Bogert, another resident of Flushing, also had his hand photographed by X rays recently. Twenty years ago he was shot in the palm. The bullet gave him no trouble and was allowed to remain. He volunteered as a subject, however, and the result shows the bullet perfectly. The hand will not be operated upon unless it should give trouble —New York *World.*

Prof. Pupin has frequently had his name before the public by his interesting work in X ray photography. This is a branch of science he has always delighted in, and his true scientific spirit shows in all his labors.

PROFESSOR ELIHU THOMSON AT THE EXPOSITION.

In spite of many pressing engagements, Professor Elihu Thomson is kindly preparing for the National Electrical Exposition a very interesting personal exhibit. He hopes to ship it to New York from New England in a few days. He has been requested by the management to include in it some of the working apparatus illustrative, in many beautiful ways, of the "repulsion phenomena," his classic investigation of which some years ago is well remembered by all electricians. An endeavor will also be made to secure a lecture from him during the exposition, as it is understood that he will be in New York at that time, and is one of the most successful lecturers of the day in explaining electricity popularly and clearly. A bust of Prof. Thomson is now being made by the Riccinilli Brothers, of New York, under the direction of the sculptor, Mr. Robert Kraus, of Boston. It is expected to be finished by the end of the month, and the original has consented to its inclusion in the collection of busts and pictures that will adorn the space of the Loan and Historical Exhibit Committee.

The National Electrical Exposition Company has recently awarded the following contracts:

To William Andrews, steam piping and fittings.
To Garrett Wright, boiler and engine foundations.
To J. E. Phelps, exclusive catalogue privilege.

Yours very truly,

Geo. F. Porter,
Secretary.

New York Notes.

Cleveland & Taylor, 5 Dey street, N. Y., are enlarging their offices—good sign of progressive business methods. They are electrical contractors, and gentlemen that deserve much credit.

SPECIAL NOTICE.

The Electrose Mfg. Co., now established at 216 William street, owing to the constantly growing demand for their wares, are again compelled to seek larger quarters and will remove May 1st, to 127–137 N. Tenth street, Brooklyn, N. Y.

They will have there some 13,000 sq. ft. of floor space, and, with a new and larger plant, be in a position to promptly meet all demands for their most successful substitute for hard rubber.

Yours truly,

Electrose Mfg. Co.

Lexington, Va.—The parties interested in the erection of an electric railway line in Brookland, who were granted permission to do so, will hold a meeting to make arrangements to begin work as soon as possible. The proposed line will run through Brookland to Horseshoe Lake, and it is proposed that the line run to Lexington C. H., if it proves successful.

New Corporations.

New York City.—The Hoosick Falls Water-Power and Light Co. Capital, $100,000. Directors, Galen C. Moses, and F. H. Twichell of Bath, and C. B. Story and George E. Green of Hoosick Falls.

Martinsburg, W. Va.—A charter has been granted the Martinsburg Electric Co., which is composed of citizens of this city, which will in the future operate the Electric Light Plant of Martinsburg. Directors, A. J. Thomas, Henry J. Seibert, L. C. Gerling and others.

Brooklyn, N. Y.—H. P. Ball Manufacturing Co., to manufacture electric appliances. Capital, $20,000. Directors, John E. E. Ball, Christopher B. Keough and M. A. Vosburgh of Brooklyn.

Pueblo, Col—The Pueblo Electric Co. filed articles of incorporation. The company will carry on a general electrical business in Pueblo. The capital stock is fixed at $10,000. F. A. and N. W. Kettler and F. L. Cuddeback are the incorporators and directors for the first year.

Bound Brook, N. J.—Articles of incorporation have been filed in the Somerset County Clerk's office for the H. S. Cash Register Co. Capital, $500,000. The company proposes to manufacture cash registers, electric carriages, dynamos and horseless wagons.

Cairo, Ill.—Egypt Elec Co. Capital, $40,000. Wm. Kluge, Henry Massenjaeger, Albert Lewis and Calvin V. Neff.

Utica, N. Y.—The Utica Suburban Railroad Co. has been incorporated to operate an electric street railway from Utica to Whitesboro and New Hartford, four miles in length. Capital, $50,000. Camille Wendenfels, of Oyster Bay, L. I.; James T. Gardiner, of Albany; C. E. Smith and John W. Boyle, of Whitesboro, and William Kernan and P. O P. Yale of Utica.

Camden, N. J.—The Camden Suburban Railway Co. filed articles of incorporation. The corporation was formed under an act to authorize the formation of traction companies for the construction of street railways, which was passed March 14. Capital, $1,000,000. Incorporators, S. Fred Hall, E. C. Leeds, of Camden, Francis R. Fithian of Bridgeton, and Alonzo P. Barrett of Haddonsfield.

THE ELECTRIC POTENTIAL.

LADIES' NIGHT.

The annual meeting and election of officers of the Electric Potential will be held at Hotel Thorndike, on Wednesday evening, April 22.

Following the dinner, Prof. Elihu Thomson will entertain and instruct the company with a copiously illustrated lecture on the Roentgen Discovery, or "X Ray."

Electrical apparatus will be employed to fully demonstrate and explain this new and mysterious process.

Music will fill the intervals.

This occasion will be one of unusual interest, and the Governing Committee has determined to request the members to invite ladies.

Reception, 6 o'clock; dinner, 6.30. Price of dinner, $2.00 per plate. Non-members receiving this notice are invited to be present by paying the cost of dinner.

A large attendance of both gentlemen and ladies is expected; and in order to properly arrange for the dinner the enclosed card must be returned to the secretary not later than Monday, the 20th inst. Frank Ridlon, President.

Trade Notes.

All the underground cables to connect the Postal Telegraph Cable Company's magnificent offices in Pittsburgh, through the underground district to the overhead lines outside of said district, were furnished and installed by the Standard Underground Cable Company, the pioneer in underground cable work of all kinds in the United States. The cables go out in two different directions, and comprise all the circuits eastward and westward from Pittsburgh.

The Standard Underground Cable Company is now laying some large underground cables for the Western Union Telegraph Company in Pittsburgh, taking in most of the Western wires of that company, and to replace several non-leaded cables of other makes.

Telephone Notes.

Milford, Del.—The new telephone line between Milford and Georgetown will shortly be put in operation.

Denver, Col.—The Colorado Telephone Co. proposes to add 9,000 more miles of long-distance copper-circuit wires.

McConnellsburg, Pa.—A telephone line is to be built between McConnellsburg, Fort Littleton and other points in Fulton County.

FOR UPTOWN TELEPHONE SUBSCRIBERS.

An uptown branch of the Contract Department of the Metropolitan Telephone and Telegraph Company has been established at 113 West 38th street (one door from Broadway), where all business relating to the supply of telephone service can be transacted as readily as at the main office at 18 Cortlandt street. There are 14,500 telephone stations in New York City. Metallic Circuit Service, Rapid, Efficient, Permanent, can be had from $75 a year.

NEW TELEPHONE COMPANIES.

Little Rock, Ark.—The Southwestern Telephone and Telegraph Co. Incorporated. Capital, $1,000,000. President, Charles J. Glidden, and Secretary, James A. Chambers.

Chelsea, Mich.—The Chelsea Telephone Co. Capital, $10,000. Lynn L. Gorton and A. W. Wilkenson.

Indianapolis, Ind.—The Crown Point Telephone Co. Capital, $10,000. George W. Fischer.

Possible Contracts.

Brooklyn, N. Y.—The Senate has passed the bill authorizing Brooklyn to expend $35,000 on the 15th Regiment Armory.

Harrisburg, Pa.—Rev. Dr. George B. Stewart, of this city, attended a meeting of the Trustees of Princeton University. He says the committee on buildings reported a handsome gift in the shape of an offer by a friend of the University, to bear the expense of a new library building. It will be built of stone and will cost not less than $300,000 to $500,000.

Brooklyn, N. Y.—The New York and New Jersey Telephone Co. has purchased a site on the southwest corner of Willoughby and Bridge streets, and a new building will be erected there as soon as the necessary arrangements can be made.

Champaign, Ill.—Arms & Hart, Imperial Building, have prepared plans for remodelling the opera house. Bids will be received April 15. Estimated cost, $20,000. Electric lighting, steam heating and ventilating.

Sea Isle City, N. J.—A project is on foot by Philadelphia, Camden and South Jersey capitalists to construct a line of electric railroads from Atlantic City to Cape May Point. The new improvement will cost $250,000.

Delford (P. O.), Hackensack, N. J.—The survey for the proposed trolley line has been completed. The route is from Fairmount at Hackensack, over private land until a point is reached near Oradell; thence to Westwood, Hillsdale and Park Ridge.

Sing Sing, N. Y.—This spring the trolley line at Sing Sing is to be extended from that village to Pleasantville, a distance of about five miles. The work will be begun as soon as possible, so that the cars will probably be running by summer.

Red Bank, N. J.—The Town Commissioners granted a franchise to the Atlantic Highlands, Red Bank and Long Branch Electric Railroad Co. to operate a trolley line in Monmouth, Front and Broad streets and Wharf avenue.

New York City.—The Board of Electrical Control met and decided to lay conduits and subways in North Moore, West, Greenwich and Vandam streets, and in Exchange Place from Broadway to Broad street. The New York Fire Notification Co. applied to the Board for permission to string wires. The matter was referred to Commissioners Hess and Hamilton.

Oshkosh, Wis.—A franchise has been granted the Oshkosh, Berlin and Omro Railroad Co. to build an electric passenger and traffic line between this city and Berlin by way of Omro, a distance of about forty miles. Under the terms of the franchise, work must be begun in four months and the road must be in operation by January, 1897.

Chicago, Ill.—The Commissioners of Public Works have readvertised for compound air electrical equipment and machinery, and locks, for North Halsted street bridge. Bids to be received April 21.

CANADIAN LETTER.

BY OUR MONTREAL CORRESPONDENT.

Electrical News.

Brantford, Ont.—A company has been formed at Brantford to manufacture the Callender automatic telephone.

Westport, Ont.—The village of Westport, Ont., is making application for incorporation; a system of electric lighting being in contemplation, as well as other improvements.

Sudbury, Ont.—Will spend $10,000 on electric light.

Hamilton, Ont.—A new incandescent light company, of which Mr. Noble Macnab is manager, is getting into shape for business in Hamilton.

St. Catharines, Ont.—The Citizens' Light, Heat and Power Co. of St. Catharines, Ltd., applies for an Ontario charter. Capital, $40,000. The provisional directors are: W. Cooke, Annie Cooke and W. H. Phillips.

Brantford, Ont.—The Brantford, Ont., Operating and Agency Co., Ltd., applies for leave to increase its capital to $100,000, to purchase the Brantford Electric and Power Co., and to change its name to the Brantford Electric and Operating Co., Ltd.

Toronto, Ont.—Under the new arrangement by which the Toronto Electric Company and the Incandescent Electric Light Company of Toronto are consolidated, it is proposed to make a considerable extension in city lighting and power. The central portion of the city will be supplied by the old incandescent plant, and by cutting off "suckers" which ramify in different directions the quality of the light will be improved. Parts not reached by the old plant will be supplied from the Toronto Electric poles and wires. It is also the intention of the company to go more extensively into supplying power, and in the future heat will also be supplied. The company's plant at the foot of Scott street will be extended.

St. Catharines, Ont.—The committee of the St. Catharines City Council, appointed to enquire into street lighting, reports in favor of a municipal plant to cost $9,125.

Montreal, Que.—A project is on foot in Montreal for substituting electricity for steam at the water-works pumping station, the electric power to be supplied by the Lachine Rapids Power Company.

J. Alcide Chaussé.

QUICK SERVICE BETWEEN NEW YORK AND BRAZIL.

BY COMMERCIAL CABLES, VIA LISBON, (EASTERN TELEGRAPH CO.)

Following is an advice from a New York patron of the Commercial Cable Co., dated April 3, 1896:

"I sent yesterday at 10.25 A. M. from my office a cable of seven words to Pernambuco, Brazil, and received the answer of seven words at my office at 12.45 P. M." (2 hours, 20 minutes.)

In Cabling Chess Moves.—"The messages went from Brooklyn to New York, thence through the Narrows and past Coney Island to Cape Canso, Nova Scotia, 850 miles; thence to Waterville, Ireland, 2,161 miles; thence around the south coast of Ireland to Weston-super-Mare, in the Bristol Channel, 329 miles, and thence to London, 143 miles more. The total distance travelled by each message was 3,483 miles, yet the arrangements were so perfect that each player knew what his opponent had done fifteen seconds after each move was made."—*Herald*, New York, March 14, 1896.

TELEPHONE PATENTS.

TELEPHONE PATENTS ISSUED APRIL 7, 1896.

558,167. Telephone-Service Register. Stephen D. Field, Stockbridge, Mass., assignor to the American Bell Telephone Company, Boston, Mass. Filed Aug. 21, 1895.

558,168. Call-Counter for Telephones. Sephen D. Field, Stockbridge, Mass., assignor to the American Bell Telephone Company, Boston, Mass. Filed Aug. 21, 1895.

558,310. Apparatus for Composite Transmission of Intelligence. Frank A. Pickernell, Newark, N. J., assignor to the American Telephone and Telegraph Company, of New York. Filed Oct. 17, 1894.

558 313. Telephone-Transmitter. Allen W. Rose, New York, N. Y. Filed Aug. 29, 1895.

ELECTRICAL and STREET RAILWAY PATENTS

Issued April 14, 1896.

558,104. Regulating Induction-Motors. William B. Potter, Schenectady, N. Y., assignor to the General Electric Company, of New York. Filed Jan. 15, 1896.

558,109. Automatic Cut-Out and Resistance-Regulator. Emil B. W. Reichel, Gross-Lichterfelde, Germany, assignor to the Siemens & Halske Electric Company of America, Chicago, Ill. Filed Dec. 27, 1895. Patented in Germany July 3, 1894, No. 83,276; in England Apr. 13, 1895, No. 7,548; in France Apr. 20, 1895, No. 223,-298, and in Italy Apr. 25, 1895, No. 38,728.

558,110. Electric Railway. Lemin W. Reid, Mound, Tex. Filed Aug. 8, 1895.

558,112. Car-Fender. George Rischmuller, San Francisco, Cal. Filed Dec. 23, 1895.

558,119. Regulating Alternating-Current Motors. Charles P. Steinmetz and Ernst J. Berg, Schenectady, N. Y., assignors to the General Electric Company, of New York. Filed Dec. 26, 1895.

558,120. Commutator. David P. Thomson and Alexis R. Goranson, Schenectady, N. Y., assignors to the General Electric Company, of New York. Filed Dec. 19, 1895.

558,122. Incandescent Lamp. Konrad O. E. Trobach, Pankow, Germany, assignor of one-half to Sigmund Bergmann, New York, N. Y. Filed Apr. 18, 1894.

558,151. Electric-Railway System. William M. Brown, Johnstown, Pa., assignor to the Johnson Company, Lorain, Ohio. Filed Nov. 29, 1895.

558,153. Electrically-Actuated Dental Plugger. Arthur W. Browne, Prince's Bay, N. Y., assignor to The S. S. White Dental Manufacturing Company, Philadelphia, Pa. Filed Nov. 6, 1895.

558,165. Electric-Wire Cleat. Fredric B. Evans, Clinton, Mass., assignor of one-half to Theodore Gould, Jr., Boston, Mass. Filed Aug. 26, 1895.

558,176. Process of Electrizing Water for Heating Purposes. Philipp Huber, Saginaw, Mich. Filed Apr. 1, 1895.

558,184. Carbon-Brush Holder for Electric Machines. William E. Knowlton, Portland, Me. Filed Feb. 19, 1896.

558,238. Electric Railway. Harry L. Tyler, Corning, N. Y. Filed July 11, 1894.

558,239. Alternating-Current Motor. Harry L. Tyler, Corning, N. Y. Filed July 19, 1894.

558,240. Method of Utilizing Saline Solutions. Chas. N. Waite, Rumford, Me., assignor to the Electro-Chemical Company, Rumford Falls, Me. Filed Mar. 19, 1894.

558,241. Method of Utilizing Saline Solutions. Chas. N. Waite, Rumford Falls, Me., assignor to the Electro-Chemical Company, same place. Filed Oct. 5, 1895.

558,252. Rheostat-Plate. Joseph P. Ball, Philadelphia, Pa. Filed Jan. 27, 1896.

558,256. Electrically-Operated Means for Controlling Valves. Charles M. Bush, Bristol, Conn. Filed Jan. 24, 1895.

558,283. Underground System for Electric Railways. Alvaro S. Krotz, Springfield, Ohio, and William P. Allen, Chicago, Ill., assignors of one-half to Oliver S. Kelly, Springfield, Ohio. Filed Aug. 23, 1895.

558,284. Conduit or Subway for Electric Railways. Alvaro S. Krotz, Springfield, Ohio, and William P. Allen, Chicago, Ill., assignors of one-third to Oliver S. Kelly, Springfield, Ohio. Filed Dec. 2, 1895.

558,299. Push-Button Switch. Harry E. Nickerson, Cambridge, Mass. Filed Dec. 7, 1895.

558,303. Electric Railway. David N. Osyor, Newark, Ohio, assignor to Joseph A. Jeffrey, Columbus, Ohio. Filed Jan. 23, 1889.

558,322. Electric Railway. Carl F. P. Stendebach, Leipsic, Germany. Filed Mar. 7, 1895.

558,343. Electric Switch. Charles G. Bergquist, Chicago, Ill. Filed June 25, 1895.

558,357. Electrical Furnace. Michael R. Conley, Brooklyn, N. Y., assignor to William Bell, New York, N. Y. Filed Sept. 25, 1895.

558,362. Electric Rheostat. Francis H. Doane, Newton, Mass., assignor to the Frank Ridlon Company, Saco, Me. Filed Sept. 30, 1895.

558,404. Car-Fender. Claude P. Mains, Cleveland, Ohio. Filed Jan. 4, 1896.

558,429. Trolley Attachment for Electric Cars. Robert Skeen, Madison, Ill., assignor to Elizabeth Skeen and Ida Bell Skeen, same place. Filed Sept. 9, 1895.

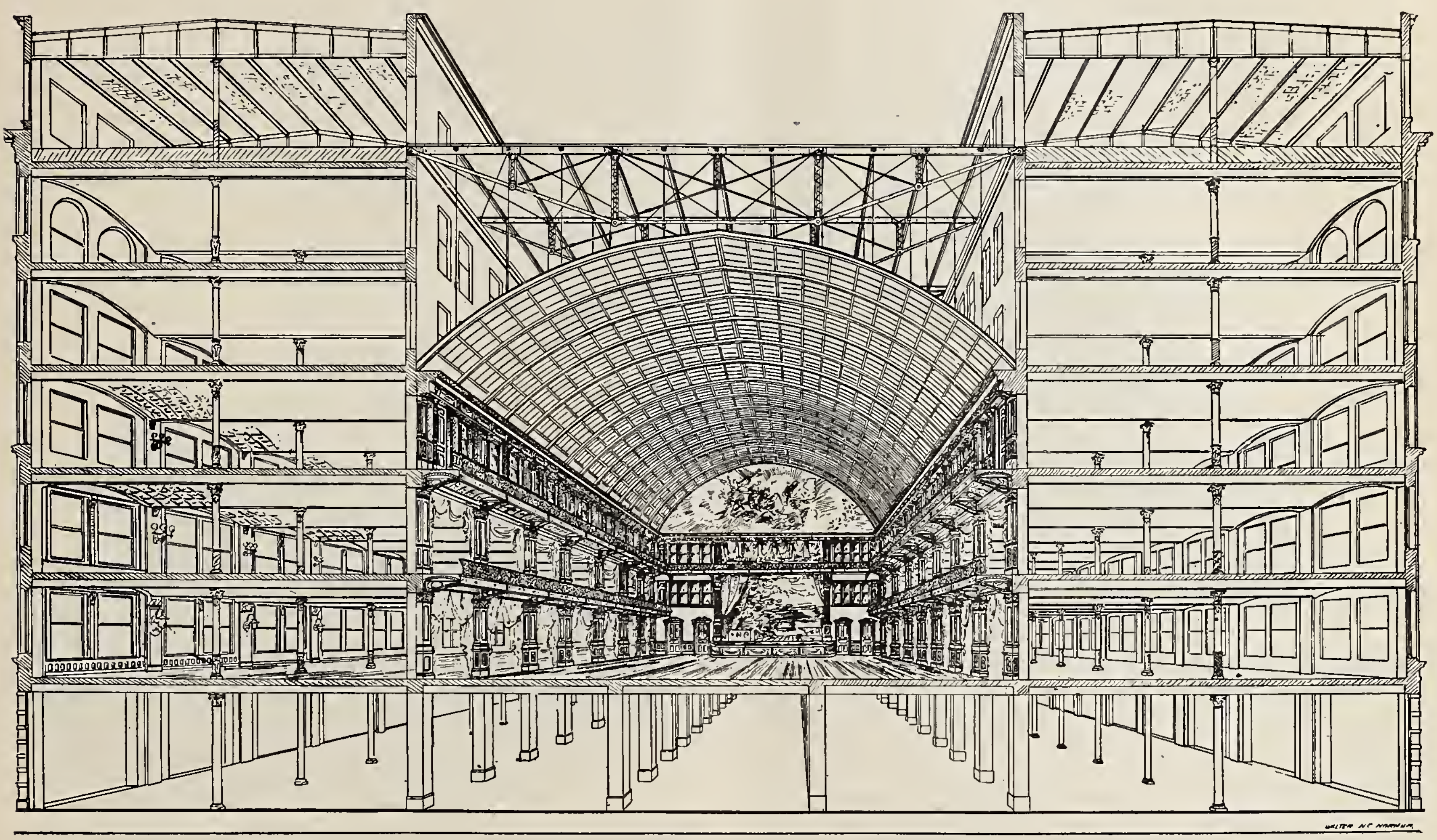
558,450. Electric Mine Cage and Elevator. Charles J. Cutler, Butte, Mont. Filed June 26, 1895.

558,453. Temperature-Regulator. Harleigh Gillette, Highland Park, Ill., assignor, by mesne assignments, to A. J. Rodgers, Chicago, Ill. Filed July 19, 1895.

558,465. Electrical Hair Cutter and Singer. Frank M. Bell, New York, N. Y. Filed Mar. 22, 1895.

The Electrical Age.

Vol. XVII., No. 18. NEW YORK, MAY 2, 1896. Whole No. 468



EXPOSITION HALL.

THE ELECTRICAL EXHIBITION.

IN CONNECTION WITH THE NINETEENTH CONVENTION OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

EXPOSITION BUILDING.

THERE is a surprise awaiting the *blasé* New Yorker. Satiated with the sight of everlasting novelties, wearied by the perpetual clamor for change, the delusions of art ultimately fail in their effect and simmer down in his mental eye to a palpable and painful failure. No wild and extravagant dream could conjure up such phantasms as the active mind produces when its opponent is nature. There are no ascribable limits to the mind of genius; no gainsaying its scope or power.

To survey the striking proofs that proclaim with silent eloquence the creative power of inventive minds is to listen once more to the oft-repeated words always new—always old, that "truth is stranger than fiction." Yes, truth is fact, and as a fact assumes shape; it becomes clothed with materiality and crystallizes from the vaporous shadow into an almost living organism. Such is the brief history of an invention, many of which the visitor will view in the exposition hall.

The National Electrical Exposition Company will begin its exhibit at eight o'clock, Monday evening, May the fourth.

Governor Morton will honor the affair with his presence, and open the exposition with a few words. There is every evidence to prove the excellence and undoubted brilliancy of this exhibit in comparison with others. Many may have exceeded it in magnitude, but few will equal it in scope and detailed finish. The many individuals that have given their time and brains to the development of this scheme will have the most unmitigated pleasure in viewing its completion. New York has often been backward in offering so unique a source of pleasure and education to the layman. With a fascinating subject like electricity to deal with, the inventions of the latter end of this century will possess a value and interest that cannot fail to impress the thoughtful mind.

The many men who have been honored with the presidency of the National Electric Light Association in the past have their names inscribed below:

James F. Morrison, of Baltimore.
Samuel A. Duncan, of Pittsburgh.
Edwin R. Weeks, of Kansas City.
Marsden J. Perry, of Providence.

James I. Ayer, of Buffalo.
Edward A. Armstrong, of St. Louis.
M. Judson Francisco, of Rutland.

The present president of the association is C. H. Wilmerding.

The association, in its happy career, has always selected some spot for its conventions congenial to all. A variety

PRES. C. H. WILMERDING.

of places have been the centre and the circle of their activity in the past, giving the members a chance to enjoy the novelty and satisfaction of new sights and surroundings, and to allow their friends and relatives, such as accompany them to be equally pleased.

CONVENTIONS OF THE ASSOCIATION..

First,—Chicago, February 25, 26, 1885.
Second,—New York, August 18, 19, 20, 1885.
Third,—Baltimore, February 10, 11, 12, 1886.
Fourth,—Detroit, August 31, September 1, 2, 1886.
Fifth,—Philadelphia, February 15, 16, 17, 1887.
Sixth,—Boston, August 9, 10, 11, 1887.
Seventh, Pittsburgh, February 21, 22, 23, 1888.
Eighth,—New York, August 29, 30, 31, 1888.
Ninth.—Chicago, February 19, 20, 21, 1889.
Tenth,—Niagara Falls, August 6, 7, 8, 1889.
Eleventh,—Kansas City, February 11, 12, 13, 14, 1890.
Twelfth,—Cape May, August 19, 20, 21, 1890.
Thirteenth,—Providence, February 17, 18, 19, 1891.
Fourteenth,—Montreal, September 7, 8, 9, 10, 1891.
Fifteenth,—Buffalo, February 23, 24, 25, 1892.
Sixteenth, St. Louis, February 28, March 1, 2, 1893.
Seventeenth,—Washington, February 27, 28, March 1, 2, 1894.
Eighteenth,—Cleveland, February 19, 20, 21, 1895.

The headquarters of the present convention is at the Murray Hill Hotel.

This hotel can lay claim to a considerable interest on the part of its visitors. The second meeting of the associatian was held here in 1885.

The first isolated Edison plant installed in this country found its resting place in the Murray Hill Hotel.

Its convenience for visitors makes it undoubtedly the best stopping-place to be found. Situated on Park avenue between 40th and 41st streets, it is near to the Grand Central Palace, at 43rd, and within easy reach of elevated roads and street cars. Its corridor and comfortable dining room will be well appreciated by the gentler visitors and satisfy even the most critical. The hotel is conducted on both the American and European plan; it is but five minutes' walk from the Exposition Hall.

The many exhibitors at the hall will have amongst their ranks a few whose names are by-words to the electrical

MURRAY HILL HOTEL, CONVENTION HEADQUARTERS.

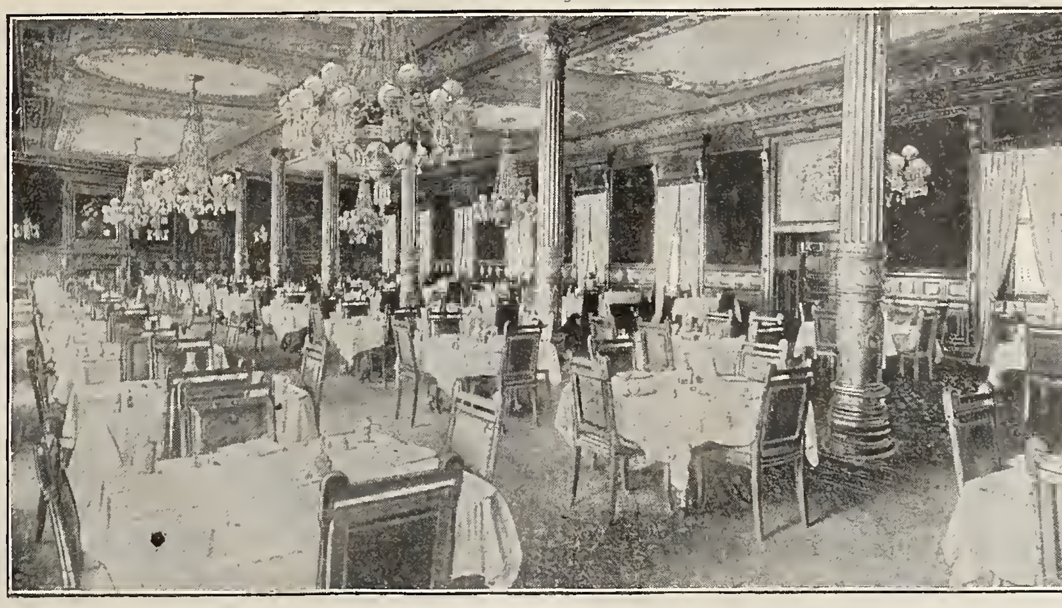
fraternity and whose labors in this course have given them well merited popularity.

One of the most attractive features of the exhibition will be an exhibit of Mr. Edison's fluoroscope, which has been made a practical instrument by the American inventor, although the first experiments with it were conducted by Salvioli. In its ordinary form the fluoroscope is a flaring box about cight inches long and tapering from a size of

HOTEL CORRIDOR.

about seven inches square at one end to two inches by four at the other. Inside and out it is covered with black cloth and has a handle on one side for the convenience of the experimenter. At the small end, through which the observer looks, are curved pieces of black felt that fit closely about the forehead and eyes so as to exclude every ray of light.

One of the most important exhibits will be that known as the Moore "etheric" lighting tubes. This is the result of the labors of D. McFarlan Moore, of Newark. In the apparatus, which is very simple, an electric current passes through a vibrator contained in a small glass tube, exhausted to the highest possible degree. The atmospheric



DINING ROOM.

resistance being removed, the vibrator is enabled to attain a rate of 100 vibrations a second. From this vibrator the current, pulsating at the same rate, passes through the lighting tubes, which may be of any size or shape and in which only a low vacuum is necessary. These lighting tubes contain no filaments, their ends being coated with metallic paint with which the wires are connected.

RECENT DEVELOPMENTS IN VACUUM TUBE LIGHTING.

A paper presented at the 105th Meeting of the American Institute of Electrical Engineers, New York, April 22nd 1896.

BY D. MCFARLAN MOORE.

MOST people have been accustomed to oil lamps, gas jets and other forms of light which have about reached their perfection. With the appearance of the arc and incandescent lamps it was thought that electricity had reached its limit in giving to the world a system of illumination that would leave nothing more to be desired. Indeed, it seems almost a presumption to dare to think of light being produced that would approach daylight in form and quality. The time is not so very remote when any man who would have attempted to manufacture sunshine would have shared the fate of a Galileo.

But fortunately the investigator of today has nothing of this kind to fear. Much arduous labor has already been expended in the solution of the problem by many eminent electrical scientists engaged in the study of vacuum tube phenomena, but the results from a practical point of view have been very meagre. This is chiefly owing to the complicated and expensive apparatus necessary, and the very unsatisfactory results even then obtainable. In fact, light from vacuum tubes, which is the only form of illumination that actually approaches nature's standard—daylight, has never been obtained in any quantity that would, in any way, be suitable for practical use. Of the other forms of electric lighting, the incandescent lamp is the most prominent. It is the peer of all illuminants in commercial use today, but is lacking, when we consider maximum uniformity in the distribution of light, and when calculations show that only three-tenths of one per cent. of the energy of the coal necessary to produce light by incandescence (its name defines its character) is actually transformed into light, it is evident that there is room for improvement. The new electric light should possess all the good qualities of the present lamp with none of its drawbacks, and among its improvements will be noted the combination of utility and decoration. The recognized tendency of the day is towards multiplication of lights and avoidance of strong shadows—in other words, an even illumination, that is; light from all directions.

The object of this paper is not only to call attention to the advantages that will accrue with the adoption of vacuum tube lighting, but more particularly to a simple method of obtaining a current which will ultimately make such an adoption universally feasible. Almost without exception, experimenters in vacuum tube lighting have hitherto sought for the solution of the problem by merely pushing to extreme well established methods based on principles long known in the art. That is, strictly speaking, no radical departures from the well-beaten paths have been as yet brought forward. However, this paper does represent radical departures; in principles, in apparatus and in the nature of the current, resulting in a light of greatly increased intensity.

Before entering upon a description of the new system,

FIG. 1.

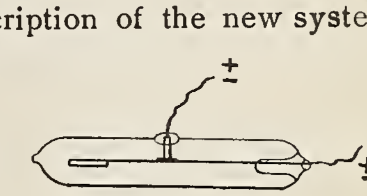


FIG. 2.

permit me to call your attention to the methods heretofore used for obtaining light from hermetically sealed glass tubes containing a rarefied gas.

For many years the Geissler tube has been a scientific toy. When a suitable electric current is connected to its terminals, its entire length is filled with a faint glow. This is, of course, a light of radically different character from that now used in any commercial form of illumination. (See Fig. 1.)

It is light emanating from rarefied air with an apparent absence of heat and combustion. Upon this principle developed, probably depends the light of the future, which will soon be, in the opinion of the writer, the "light of the present." As a device for transforming electrical energy into light, the vacuum tube is very efficient. The majority of authorities place it at about 70 per cent. and the incandescent lamp at two per cent. Notwithstanding this remarkable efficiency, it has never been commercially possible to illuminate by vacuum tubes, because the light could not be made sufficiently intense (this is expressing it mildly) even with bulky apparatus that was entirely impracticable.

Furthermore, the current produced by such apparatus was of such a nature as to render its insulation extremely difficult. The ordinary induction coil is often used for this purpose. A current of low voltage, such as that from a battery of a few cells, must be used with such a coil, because a current of higher voltage could not be properly disrupted, the arc forming preventing a sudden break of the current. But since the light depends on the suddenness of the break the arc must be prevented, therefore the quicker the break, the brighter the light—provided the apparatus is properly designed.

The quickest break can be made by interposing in a circuit the most perfect dielectric in the minimum space of time. The best dielectric known is a vacuum, and I have discovered methods for interposing it in rapid succession in a current in a minimum space of time, depending upon the principle of making and breaking a current rapidly in a vacuum.

The disruption of any current in the air results in the formation of a spark of greater or less length, and the greater its length, the less sudden the break. Therefore, if the break be made in a vacuum, the narrowest conceivable complete gap in the metallic conductor results in an almost instantaneous discontinuance of current, ensuring a maximum C. E. M. F. The current is thus interrupted in an almost infinitely short space of time as compared with all the ingenious mechanical contrivances, such as air-blasts and magnetic blow-outs devised for the purpose of breaking a current suddenly in the open air, but all of which are of little avail for the production of any quantity of light.

The vacuum vibrator, as shown in Fig. 2, is the nucleus of my invention. Although an exceedingly small device (not as large as one's finger) it demonstrates when in circuit with a small magnet (not as large as a teacup,) a principle embodying great possibilities. It is a new piece

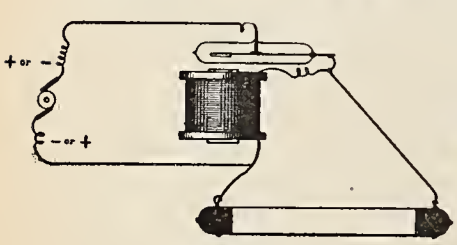


Fig. 3.

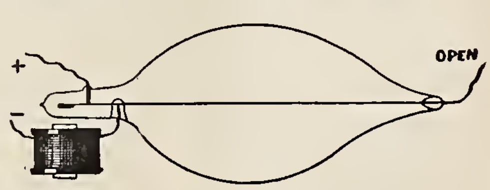


Fig. 4.

of apparatus, exemplifying a principle of value not only applicable in practical use, but also an improved implement for scientific investigation.

It is almost unnecessary to describe such a simple piece of apparatus, which consists merely of a spring rigidly supported at one end, and having attached to its free end a small disk of soft iron. A contact point rests against the spring at about its centre. A sealed glass tube, from which the air is exhausted, encloses both spring and contact point. The system, as a whole, is exceedingly simple. An electric current passes through a coil of wire and then through the vacuum vibrator. Wires in contact with the outside of each of the ends of a closed and empty glass tube are attached to the two ends of the coil of wire. This statement embodies the gist of the invention. (Fig. 3.) It will be noticed that this system is far simpler than the apparatus ordinarily used to excite Geissler tubes. The secondary coil is absent, reducing the expense and bulk many fold, as are also the metallic terminals sealed into the ends of the Geissler tube, but it produces light, the desideratum, in wonderfully increased volume.

With this apparatus, currents of almost any voltage can be rapidly and suddenly interrupted, and it is therefore now possible to obtain, by using ordinary commercial currents, strong light in vacuum tubes.

When the circuit through the magnet and vibrator is closed, the armature within the vacuum vibrates rapidly, disrupting the current within the vacuum at each vibration.

The resulting high-tension current excites a brilliant luminosity in another tube, usually of much larger dimensions, and containing a lower vacuum than the vibrator tube. There is, therefore, a necessity for two vacuums, one the very highest, the other very low. However, I have tried a number of experiments, using but one vacuum, practically amounting to an enlargement of the vibrator tube and a lowering of its vacuum. (See Fig. 4.)

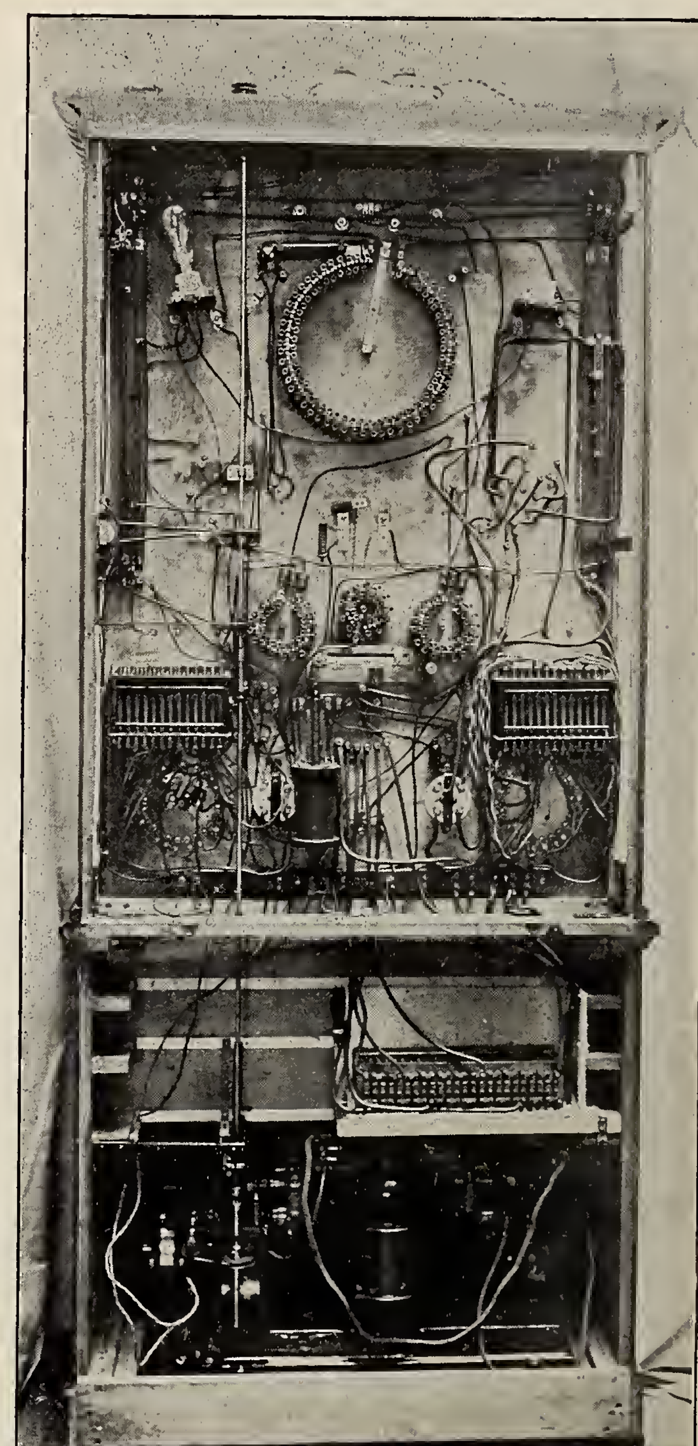
This is manifestly not a good plan for the production of light, because the breaking of the current does not occur in a high vacuum, but it led to an interesting line of experiments, the most novel of which will now be brought to your attention.

(*To be Continued*).

AN ELECTRO-THERAPEUTICAL CABINET.

THE cabinet shown in the accompanying illustrations was constructed according to the designs and suggestions of Dr. Frank Heuel, by Messrs. J. C. Vetter & Co., of this city, and demonstrates the scientific, most delicate, and safe manipulation of the Edison constant current as applied in electro-therapeutics.

Through it can be obtained, by a simple connection with the ordinary lamp socket:



1. The galvanic current.
2. The faradic current.

3. Combined galvanic and faradic currents.
4. The sinusoidal current.
5. Various modifications of the above.
6. The cautery current, for heating electrodes and wire loops.
7. Current for the illumination of all kinds of diagnostic lamps from the smallest, as used in the cystoscope, to the largest of 100 candle-power for transillumination.
8. Motive-power up to one horse for surgical drilling, sawing, etc.

Any and all of these currents may be modified in any way desired.

The cabinet consists of an upper and lower compartment. In the upper compartment are the various translators, meters, switches, safety devices, etc., fastened to a slate-back and base. To preserve them from dust and injury, they are protected in front by a removable plate-glass door, and in the back by a removable board. On the top of the cabinet is a fuse-box with cable connection for any ordinary lamp socket. Also a vibrator bell for the "timing device."

The lower compartment, as shown in the illustrations, has above, a sliding-shelf the entire width of the cabinet, for laying on instruments, etc.; below, a number of drawers for various articles to be used in connection with the cabinet. At the bottom is a removable front, made to represent two large drawers. Behind this are the motor, dynamo and alternator, on a separate moveable platform supported by heavy rubber-shod castors, so that they may be easily inspected or repaired without moving the entire cabinet, which is on separate rollers.

On the slate-base of the upper compartment are three sets of good-sized binding-posts, connected below with three sets of conducting cards or cables, which roll up automatically on reels and are self-fastening, so that any length up to 20 feet may be used as required. When not in use the metal tips of each cable are placed in separate wooden grooves in the small drawers underneath each set of binding-posts, so that they are out of harm's-way. The end of each conductor has a narrow red or blue collar interwoven to indicate its polarity.

The left-hand set of binding posts and cable is for the cautery current; the middle set for galvanic, faradic, sinusoidal, or combined currents; the right-hand set for the illuminating current. In this arrangement the different currents can be used together or independently of each other. On the slate back are fastened :

1. The meters.

a A milliampere meter for indicating the current-dose given to patients. It has three scales—the upper from one to twenty-five; the middle from ten to two hundred and fifty; the lower from thirty to seven hundred and fifty milliamperes, and is provided with a neat switch for placing it in or out of the patient's circuit and for selection of scale.

b A voltmeter to indicate the voltage used on patient's circuit or Edison main. In circuit is a "volt-equalizer" (Vetter's) for use in case the voltage on the main line should exceed one hundred and ten volts.

c An amperemeter, which indicates the amperage consumed in driving the motor-dynamo and the amperage used for individual cautery electrodes or loops.

2. Rheotomes.

a Vibrator for galvanic current.

b Vibrator for faradic current.

c High tension ribbon vibrator for faradic current.

d Automatic clock-work vibrator for all currents, capable of from thirty to one hundred interruptions per minute.

3. Current selector switches.

a Switch for selecting the galvanic, faradic, sinusoidal or combined current.

b Switch for selecting faradic coil, with buttons marked to indicate length and calibre of wire used.

4. Scale, with sliding button to indicate length of soft iron core within faradic coil.

5. A lever switch to regulate the speed of the motor-dynamo.

6. A commutator or pole-changer, over the middle set of binding posts, to indicate the direction of the current and change it as required.

7. A "timing device," which can be set to ring a vibra-

tor bell on top of cabinet at the end of from one to thirty minutes, for timing the application of the current.

8. An "electro-thermal cut-off," which automatically cuts off the supply current from the cabinet at the end of a specified time. In case the current should inadvertently be left turned on, there will be no waste of current.

9. Incandescent lamps for controlling the amperage of the various shunt currents.

10. A Vetter "volt controller" (large circular switch near top, between meters), by which any pressure from one to one hundred and ten volts can be obtained for the galvanic circuit. The amperage is regulated by a "Vetter carbon current controller" (in centre of slate base), through which from a fraction of a milliampere up to one ampere can be applied with absolute certainty, and so imperceptibly that no sudden shocks to the patient are produced. This rheostat is always in circuit for the various currents.

The faradic current is gained through a long coil, made of wire of varying calibre and lengths, and tapped at different points. It is modified by the various rheotomes, volt, and ampere controllers, which give great range of current variations of quantity and quality, and precise dosage.

The sinusoidal current is obtained from an "alternator" operated by the "motor-dynamo." In addition to being controlled by the adjustable speed of the "motor" it may be modified by the automatic clock rheotome, volt and ampere controllers.

The "motor-dynamo," capable of developing one horse-power, and using from two to five amperes of current, also supplies a cantery current from five to sixty amperes, and twelve volts, which is under perfect control by a special rheostat. It also furnishes power for surgical drilling, sawing, etc., by means of the flexible cable attached at the middle and right hand side of the upper compartment.

The illuminating current is obtained from the main line supply and modified through the lamps and an appropriate rheostat.

Special attention is called to the facility of practically and scientifically manipulating the various electric currents, and the absolute safety with which the same can be applied through this apparatus.

ROENTGEN RAYS.

Plants and Light.—Siemens made a series of experiments on the influence of the electric light on vegetation. The light was produced by a dynamo electric machine of his own construction, and was equal in illuminating power to 1,400 candles. Of a series of four sets of quickly growing plants in pots, such as mustard, beans, etc., one set was left in the dark, and two other sets were exposed to the action of daylight and the electric light separately, while the fourth was exposed to the joint action of the two lights. The first set withered and died; those exposed to the electric light grew and flourished, but not so vigorously as those exposed to daylight alone; there was, however, a marked improvement in the case of those which had been exposed to the conjoint action of both lights; they showed the most vigorous growth. Plants did not seem to require a period of repose, but made increased and vigorous progress if subjected at daytime to sunlight, and by night to the electric light.

Color of Discharges.—A change in current often produces an entire change in the color of the stratification, thus in hydrogen the change is from blue to pink. If the discharge is irregular and the strata indistinct, an alteration in the strength of the current makes the strata distinct and steady. The color of the discharge in one and the same gas greatly depends on the degree of rarefaction. The least resistance to the discharge in hydrogen, and when its brilliancy is greatest, is at a pressure of 0.642 mm., or 845 millionths of an atmosphere. When the rarefaction has attained 0.002 mm., or three-millionths of an atmosphere, the discharge only just passes, even with a potential of 11,330 volts; with an exhaustion of 0.000055 mm., the nearest approach to a perfect vacuum ever attained, not only does this fail to produce a discharge, but the one inch spark of an induction coil does not pass.

INQUIRY COLUMN.

In this column we shall endeavor to answer all questions relating to the science of electricity that may arise in the minds of our subscribers.

(*Q.*)—**Electrical Launch.**

New York, April 26, 1896.

Electrical Age.

Can you let me know how to run an 18-foot boat in the cheapest manner? I have a good hull and would like to equip it as a launch. Are batteries cheap for motive power in such a case? Kindly answer and oblige.

Yours respectfully,

James Kennan.

(*A.*)—The cheapest power for boats of that description, including the motor itself, is a small steam outfit. A naptha outfit is more expensive, although the fuel is cheap. Batteries for launch work are excellent, provided you care to handle the chemicals. It is dearer than any other, but novel, and if carefully cared for, most satisfactory. A small ¼ horse-power motor, with a dozen bichromate cells, would not be expensive if your own labor is applied at their installation. Usually storage batteries are used for launch work, though more often when the vessel is large. To quote from a writer on the subject, "If a good battery be obtained for which no extravagant claims are made, and if the boat be equipped with almost any one of the large number of small motors on the market, its owner should be able to derive many pleasant hours from its possession with absolute, or almost entire respite from the fatigue of rowing or the care of tending sails." The same writer estimates the apparatus complete for a 12-foot boat, having a speed of four miles an hour, as costing from $150 to $250, and about fifty cents a day for cost of zinc, etc.

(*Q.*)—**Regulation of a Dynamo.**—

Sandusky, Ohio, April 21, 1896.

To the Editor Electrical Age.

Dear Sir:—My dynamo has something the matter with it. It is a shunt-wound machine and does not change the lamps when I use the rheostat in the field. Up to a certain point the light increases when I use the box, but after a few brass slips are passed I am helpless.

How shall I make it regulate—must I get a new box? I forgot to mention that even when all the resistance is cut out of the field the lamps don't change and become brighter.

Arthur Simpson,
Engineer.

(*A.*)—The rheostat controls the field but a slight extent. The light of the lamps does not increase the ordinary brightness with all the resistance out of the field. This shows, 1st, the pressure is too low to begin with, and 2d, the fields are not effective at that speed. To remove this difficulty speed up the dynamo by using a smaller pulley, and we think the rheostat will regulate and the light from the lamps become more satisfactory.

(*Q.*)—**Sparking.**

St. Louis, Mo., April 4, 1896.

Electrical Age.

To the Editor:—I consult your valuable inquiry column on the following matter:

My dynamo works very excellently, as a rule, but I have noticed that when the load passes a certain point the sparking from that time on begins to increase until at full load it becomes very severe. I keep the commutator well turned and the brushes properly set.

Frank M. Mannie.

(*A.*)—The armature reaction in your dynamo is very severe at full load. The fields should be strengthened and the sparking would disappear to a great extent. Have the machine compounded, if you can.

Ramapo, N. Y.—The Ramapo Town Board has voted to put sixty electric lights through the village of 20-candle power each, to cost $15 per light.

The Electrical Age.

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NEW YORK, MAY 2, 1896.

CONTENTS.

LET THERE BE LIGHT.

Since the first edict was thundered forth from the vaults of space the world has undergone a change. It is not the charm of color that arouses the deepest sentiment, but the first wan light stealing from the East—the bluish dawn with its hesitating advance and flood-like embrace. Many years ago the strange conclusion was arrived at that light was like the sand, or the water—a material thing. Sir Isaac Newton believed it to be due to the emanation of myriad particles—a blow upon the curtain of the eye of uncountable and swiftly moving atoms. The corpuscular theory was the first definite conclusion arrived at, and it might have been still more correct had some idea of the existence of so tenuous and elastic a medium as the ether crossed the mind of its illustrious originator. But the ether was not the fact; it was merely the product of it. It simply became a modern idea when an explanation was sought; its existence was then verified.

The phosphorescent sulphur ball, glowing with cold-light, was the extraordinary phenomenon presented to the gaze of Otto Von Guericke. The awe-struck sailors viewed the lambent light of St. Elmo's fire creeping about the yard-arms with the same unspeakable sensations. It is not alone these few that had awakened in them some element of thought by this ghostly light. Faraday, Maxwell, Hertz, and a host of latter-day scientists saw in this "will-o'-the wisp" more than an *ignis fatuus*; they saw in it the beginning of new discoveries and possibly a new and useful source of light.

Since the flickering aurora was seen by the Norseman and Vikings of old, its spectral presence has been the basis for many strange traditions. Like the rainbow, it entered into their superstitions and mythological tales.

It is this continual notice taken of so strange a light, not by the individual alone but by entire nations, that affects us today. To produce light without heat; to do what nature has done in her own subtle way for unrecorded ages; to follow in the footsteps of those whose efforts gave impetus to the science and whose ambition was lofty in its commendable object.

This is the work laid out for those that will enter the arena. Tesla has drawn aside the curtain and given us one glimpse of the glories within. There have been others silently achieving success. McFarlan Moore, whose work in this inviting field has been publicly described, is approaching his goal. Etheric light he calls the glow within his tubes. That is the light we want. Apart from the closer influence of grosser matter etheric light is lambent, soft, diffused and pleasant. In contact with it we have an undesirable heat and a loss that pains the mind on contemplation.

The ether waves, undulating outward at the rate of many millions per second, comprise the underlying principle of light. With a vibrator in a vacuum, a break of unequalled suddenness and resistance, occurs. The ether waves are shot through the tube and the phosphorescence with dawn-like purity radiates as the softest illumination.

THE EXPOSITION.

The habit of having expositions or fairs has possessed the mind of civilized man since early ages. The ancient Romans had feasts instead, that assumed at times the most prominent position in the public eye. The attractions of the Coliseum also broke the monotony of their existence. Fierce fights—powerful antagonists, that neither spared nor expected to be spared, completed the scenes of those times—scenes that were but frightful massacres in their outrage of all civilized codes. Spain still delights in her bull fights, but the northern races have tired long since of these gay spectacles. The tide of reform has swept them away like drift-wood. The educational effect of any fair of note is strikingly apparent. The fact that it supplies the place of an open book, that it readily teaches with all the charm of novel surroundings, is evidence in itself that the strongest impressions are received. The fairs have always become better. They are noteworthy in this respect; the Crystal Palace, the Paris Exposition, the Chicago Fair, are "steps" in the line of advance.

The Electrical Exposition in New York is in many respects the most interesting of its kind. The latest inventions will be seen with their inventors still living. We are so accustomed to digging up antiquities and then emblazoning the name of its long-forgotten orignator on top that the absence of such scenes in this case will be very striking.

The opening night will provide a scene that will fill our hearts with pride—our own city, our own governor and our own unique exhibit.

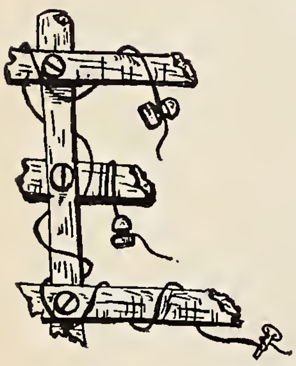
If a man possess the right to feel inflated with a sense of complacency it is on this occasion. We congratulate the management, always so easily forgotten, for the unqualified success which will undoubtedly typify their work. Like others, whose anticipation is on the verge of enthusiasm, we applaud before the curtain rises. We wish success to the president of the National Light Association and all its friendly supporters.

We must not forget the able secretary of the association, Mr. George F. Porter, and Mr. Clarence E. Stump, the manager, whose combined efforts have made the affair a success and an almost municipal event.

THE TESTING OF LINES.

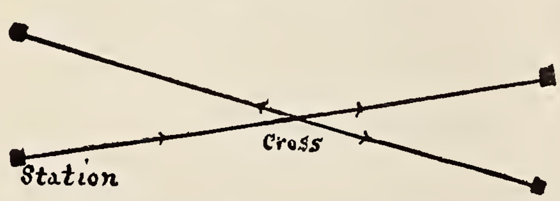
LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.



ENTIRE freedom from crosses and grounds on a line is secured by constant attention, regular testing and inspection. When a line is crossed with another line the signals sent over the first do not reach their destination but affect the sounder of some other station not supposed to receive the impulse.

Crosses.—Not only may this occur but the current may return to a ground circuit, if the cross brings it into contact with such, and also become lost, as in the first case. Crosses therefore may be looked upon as causing a straying of signals, or possibly their complete disappearance. The location of a cross is made by testing the line. Should its resistance be greater or less than is usual the trouble is at once indicated, but not its nature. A ground is likely to assume the same appearance as a cross when superficially tested. A cross can therefore be discovered by the fact that the resistance of the line has changed, and also by a lack of signals at the other end. Each station has its own peculiar signal to receive when communications are to begin with any other.



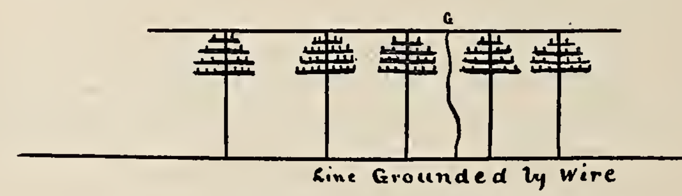
A cross may thus create a disturbance in either one or more lines, and by a resistance test be located. When a difficulty of this kind occurs with an electric light line a set of fuses will blow and save it. A source of trouble that is very irritating to a telegrapher, and which fortunately occurs very infrequently, is the swinging of telegraph or telephone lines. They may touch for a long while when the wind blows, or only occasionally, causing a temporary cross or ground which when looked for disappears to return at odd moments. *Swinging crosses or grounds* are best removed when the line is at rest; the early morning or evening or whatever time allows for such investigation. The loss of conductivity in a line may be traced to several causes. One of the most common is poor connections, etc. If a line is free from all difficulties, its length should represent a definite resistance when tested. The tests made for conductivity are simple; they differ from those made for insulation resistance in degree merely, in all other respects being identical.

Breaks.—A break in a line necessarily destroys all means of communication with the other end, unless the broken portion lands in a brook or on another line. If the ground connects the broken end, a test made of the resistance of the line will disclose the fact that it is incomplete. If the resistance of contact is high, the familiar features of partial ground manifest themselves without, however, any signals being received at the other end at all.

Grounds.—When the line falls into contact with the earth it is like to do so in two ways; they are spoken of under the following heads:

Dead grounds,
Partial "

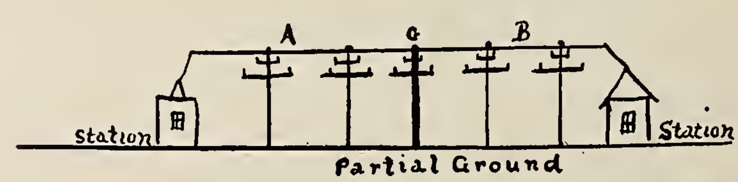
Dead grounds.—A dead ground is so called when the contact between the earth and the line is electrically good. A pole may be decayed inside, saturated with water and practically ground the line as well as if a plate were used. The pouring rain may stream down the pole, or a collection of them, and cause a dead ground. In this case the signals cannot possibly reach the other end, but return home through the faults. A wire hanging from the line to the earth and touching a grating or a cornice, or even piping of some description, produces this defect. Its location is found by measuring the resistance of the line. If, for instance, the normal line resistance = 100 ohms and the test shows only 80 ohms, the ground exists at a point $\frac{8}{10}$ of the distance from the station; this, remember, is based upon the supposition that the line is dead grounded at that point. In making the test, one end of the line is connected to the Wheatstone bridge and the other end



leading from the ground plate also to the Wheatstone bridge. The circuit is now complete through the line, dead ground, earth and Wheatstone bridge. The resistance of that portion of the line in contact with the earth and between the ground and the station is thus found. Its resistance in ohms represents an equivalent in feet. It may be 10 ohms per mile or 100 ohms per mile; in any case, this data determines its position.

Partial Grounds.—This common fault develops due to many causes, such as contact of the wire with a tree, or the leakage due to very poor insulation at any given point of the line.

In testing a line for a partial ground the position of the



leak is determined by a double test. Calling one telegraph station A and the other B, the line between would be called A B. The ground G is of a resistance that in each test is included with the resistance of that part of the line from which the test is made. In measuring the resistance of the line from A, the circuit is opened at B. Therefore, the resistance measured is equal to that through A and G back to the station. This being done the line is opened at A and tested from B; the resistance is measured through the B portion of the line and G.

Test (1) resistance = A + G.
" (2) " = B + G.

The rule employed for finding the position of the ground from A and from B is as follows:

Resistance of A portion of line =

$$\frac{\text{Resistance of test (1) + resistance of (A+B) — resistance of test (2)}}{2}$$

or conversely the resistance of B portion of line =

$$\frac{\text{Resistance of test (2) + resistance of (A+B) — resistance of test (1)}}{2}$$

The resistance of the entire line is known either by its length in miles of a given size of wire, or by a resistance test.

Taking a case in practice as follows: A line is grounded and a test made from each end through the ground with this result:

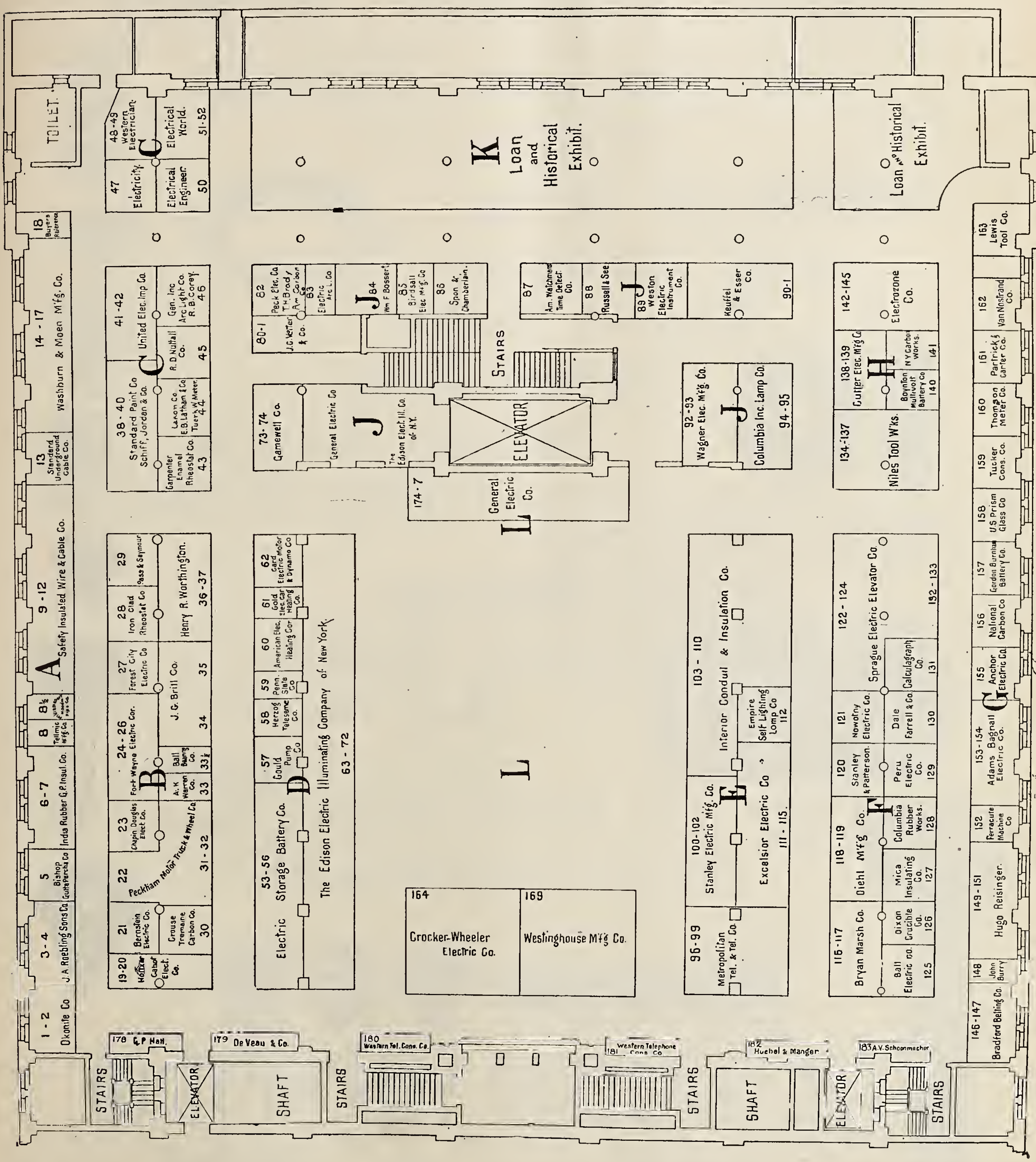


DIAGRAM OF MAIN FLOOR OF EXPOSITION, GIVING NAMES OF EXHIBITORS, NUMBER AND LOCATION.

Test (1) from A through ground = 1075 ohms.
" (2) " B " " = 1025 "

To find the number of ohms the ground occurs away from either A or B, the rules are applied and, when the ohms are known, the distance is understood.

If the line had 10 ohms to the mile its location would be (if the line has 100 ohms resistance)-

$$\text{From A} = \frac{1075 + 100 - 1025}{2} = 75 \text{ ohms}$$

$$\text{From B} = \frac{1025 + 100 - 1075}{2} = 25 \text{ ohms}$$

at 10 ohms to the mile the ground is

7.5 miles from A
2.5 " " B.

This test applies equally well to telephone, telegraph and electric light lines.

The cross talk on telephone lines is due to the electromagnetic or electrostatic induction occurring.

The electrostatic seems to be the most effective in producing the trouble so familiar to all. The remedy for this is applied by twisting the wire; the inductive action being neutralized throughout by this means.

Covering the wire with an iron inductive coating of the best possible description will tend to reduce this difficulty to a great extent. At times the most novel practices are employed, such as surrounding the wire with crimped paper, etc. This is done to embody as much air as possible in the covering; air having a less inductive capacity than other materials, and therefore prevents induction to a considerable extent.

The usual tests made of a line bear reference to its

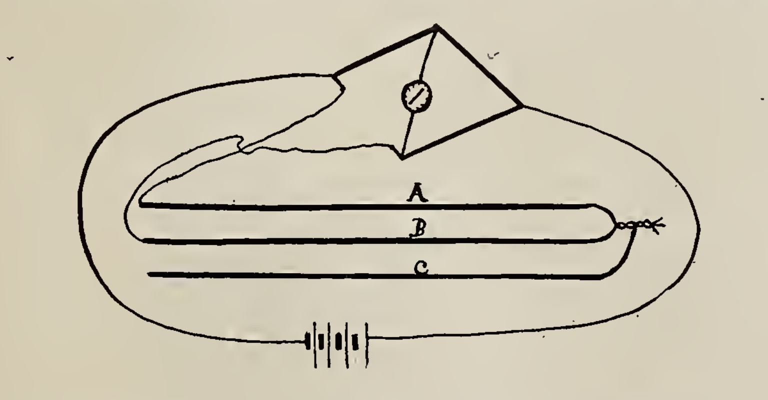
Conductivity,
Insulation,
Capacity.

A sensitive galvanometer and a bridge will enable these tests to be successfully made.

Conductivity of one wire.—This is found by grounding one end and allowing the other to go to the arm of the bridge, measuring the unknown resistance, and then to the earth. The earth resistance being zero, the line may be measured.

Conductivity of a line by means of another.—If two lines lie side by side they may be measured without grounding, provided they be of equal gauge. Their extreme ends are twisted together and the other two ends connected to the bridge arm. The total resistance measured divided by two will equal the resistance of either.

To measure the conductivity of three lines.—If three lines of the same or unequal resistance are side by side, and



the resistance of each respectively is to be found, three tests are essential by this method.

Calling the three lines A, B and C, the three tests take in the combined resistances of A and B, of B and C, and of A and C. This is obtained by joining their ends all together, leaving the three other ends free for the tests.

tests (1) resistance of A + B
" (2) " " B + C
" (3) " " A + C

The rule to be applied is then as follows:

$$\text{Resistance of A} = \frac{\text{test (1)} + \text{test (2)} + \text{test (3)}}{2} - \text{test (2)}$$

$$\text{Resistance of B} = \frac{\text{test (1)} + \text{test (2)} + \text{test (3)}}{2} - \text{test (3)}$$

$$\text{Resistance of C} = \frac{\text{test (1)} + \text{test (2)} + \text{test (3)}}{2} - \text{test (1)}$$

The last is not necessary, as C may be found by subtracting A and B from

$$\frac{\text{test (1)} + \text{test (2)} + \text{test (3)}}{2}$$

To illustrate this case

test (1) = 110 = A + B
" (2) = 130 = B + C
" (3) = 100 = A + C

$$\frac{\text{test (1)} + \text{test (2)} + \text{test (3)}}{2} = 170 \text{ ohms.}$$

Then A = 170 — 130 = 40
B = 170 — 100 = 70
C = 170 — 110 = 60

Thus the resistance of lines may be determined irrespective of their size by this method.

The drop of potential in a line is very great, being more than the average in very dry weather and less in wet weather. If a line has a change in insulators the percentage of current received is shown by the following table, prepared by Moses G. Farmer.

"Distances in miles a percentage of the current will reach through a line of 18 ohms to the mile and the following insulators:"

Percentage of Current Received.	Insulation Resistance in Megohms, 30 Insulators Per Mile.							
	Megohms 1	4	9	16	36	100	1000	1600
10%	Miles 125	258	386	516	774	1290	4094	5160
25	89	178	267	356	534	890	2837	3560
50	58	116	174	232	348	580	1850	2820
75	36	73	109	146	219	365	1161	1460
90	22	45	67	90	135	235	766	900

The *Electric Telegraph*.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

At the 105th meeting of the Institute, held at 12 West 31st street, New York City, April 22, about 200 members and guests were present. A paper was read by Mr. D. McFarlan Moore, of Newark, N. J., on "Recent Developments in Vacuum Tube Lighting." It was accompanied by numerous experiments, and the hall was lighted with tubes, which were suspended horizontally from the gallery in a double row. Owing to the lateness of the hour of adjournment there was no discussion.

It was decided to accept the invitation of the National Electrical Exposition Co., and hold the annual general meeting in the Exposition Building, beginning on May 19.

WILMINGTON, DEL.—Philadelphia capitalists are negotiating for the purchase of the charter of the Wilmington and Chester Electric Railway Co., with a view to constructing the road.

PRINCIPLES OF DYNAMO DESIGN.

BY

Newton Harrison E.E.

(*Continued from page*) 202.

SOME plants are installed without regard to locality or immediate surroundings, yet there are times when conditions forbid the use of dynamos, unless expressly designed to meet with such trying circumstances as are apt to destroy one of ordinary construction or endanger the lives of those in its vicinity. In coal mines the issuing fire-damp would at once ignite if a badly sparking machine were to be used. This applies equally well to a motor; also dampness and moisture, heat and dust will be fatal to the smooth running of either motor or dynamo. They are to be met with in many cases and should be recognized. It is only when carelessness or ignorance on the part of those installing the machines is forcibly brought to our minds, by the troubles and difficulties afterward developing, that this fact is appreciated.

A heated atmosphere makes a normally loaded machine behave as though it were overloaded, if not of a larger size to make up for this noticeable inefficiency.

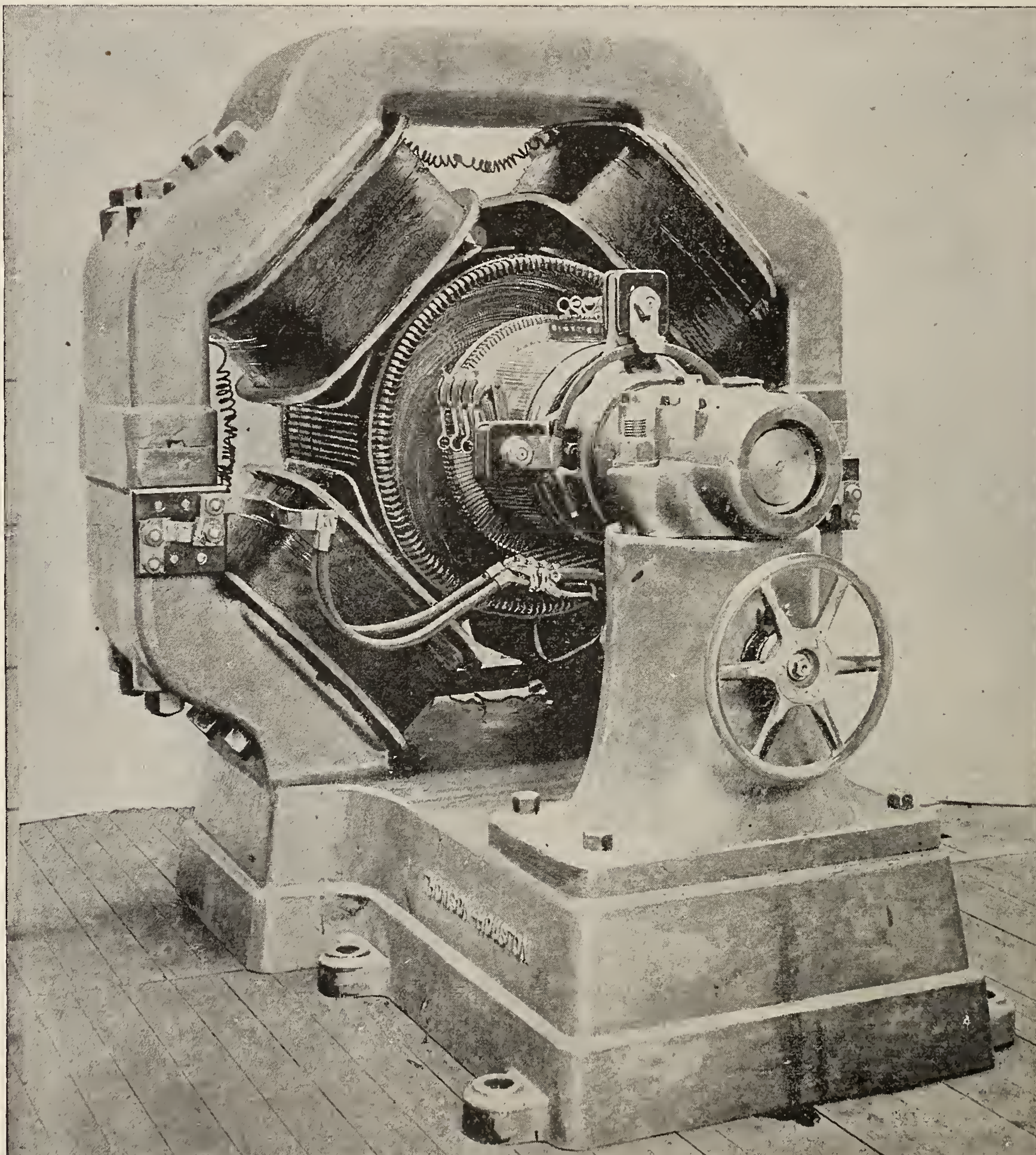
For mining work a well protected aud heavily built machine is always most effective. It is best able to withstand the rough treatment, and best equipped for heavy draughts of current or power than any other.

When the fact is considered that in the Mississippi Valley there are at least 152,000 square miles of coal area, some room is to be found for the application of motors and dynamos to help in this immense industry. The processes of excavation and its preliminaries of drilling are today successfully carried out by means of electrical machinery.

So-called direct blow machines are used in mines with a 4 H.-P motor attached.. A heavy projectile with a pick secured at one end is able, by means of a spring, to give a blow of 1,000 lbs. at least. The blow is given about 200 times a minute, and the motor absorbs about 10 amp. at 220 volts. The projectile weighs between 100 and 150 lbs. To quote from a writer on the suuject, "Early in the development of this machine it was found that under the action of the intense concussion resulting from the percussive blows and shattering strain throughout the machine, a motor to last under such conditions must be essentially different in its organization from the ordinary commercial machine."

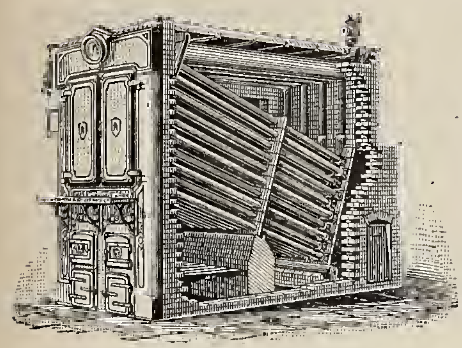
The details of mining drills, and the system of machines and inventions used to further the work, comprise a special subject of large scope and deep interest.

(To be Continued.)



MINE GENERATOR.

THE STEAM BOILER PLANT OF THE NATIONAL ELECTRICAL EXPOSITION.



In presenting to the public an exhibition of electrical machinery and appliance, which include practically everything of consequence in this line, the National Electrical Exposition Company decided that such an exposition would not be complete without a steam boiler plant up to date in every sense of the word, whereupon a special committee was appointed to secure a strictly modern plant which would include only the latest appliances in the market.

The improved Root water-tube boiler, manufactured by the Abendroth & Root Manufacturing Company, of New York, was thus selected to furnish all the steam used at the exposition, there being two equal units forming one battery of five hundred horse-power of boilers. The well-known anthracite automatic stoker, manufactured by the Wilkinson Manufacturing Co., of Bridgeport (Montgomery County), Penn., was selected to handle the coal supplied to the fire.

The coal, after being dumped at some distance from the boilers, in the rear, is taken by the C. W. Hunt coal conveyor and carried along the side and a little past the front of the boilers, where it is elevated to a point near the ceiling, from whence it is delivered through tubes to the hoppers of the Wilkinson stokers, and, of course, from that point it is fed uniformly down the inclined grates, burning on its way and reaching the foot of the grates as ash, and finally we find it dumped into the ash-pit below.

The Hunt conveyer next takes the ash and carries it back to a dumping place some distance in the rear of the boiler, dumping it there automatically. Thus we find our fuel well cared for automatically.

The pump supplying feed-water to the boilers is one of the H. R. Worthington Company's make. It will be electrically driven by one of Crocker-Wheeler Company's pump motors. The pump is one of the "steeple pattern," and combined with its motor presents a novel and elegant appearance.

Thus the entire working of the boiler is made automatic, with the exception of the damper regulation, and here the Locke Damper Regulator Company, of Salem, Mass., comes to the rescue with one of their damper regulators, and this completes the entire automatic equipment.

The visitor to this exposition will find many other very attractive and useful features which will well repay his careful investigation. The valves used in the main steam piping, for instance, are especially adapted to high pressure and ordinary rough handling.

The pressure carried by the boilers will be 125 pounds. This pressure will be carried along the main steam piping to a point just beyond the first engine, and there it will be reduced by a Foster reducing valve to 90 pounds, at which pressure it will be carried to all of the other engines on exhibition.

The boilers are equipped with steam gauges manufactured by the Ashcroft Mfg. Co., and with nickel seated pop safety valves made by the Consolidated Valve Co., both of New York and Bridgeport, Conn.

The exhaust piping from the eleven engines will probably interest many of the visitors to the exposition, as it has been used by so many electric light companies for this purpose. We refer to the spiral riveted pipe made by the Abendroth & Root Mfg. Co., of New York.

The battery of improved Root boilers used at this exposition is an exact duplicate to the twelve batteries of boilers used at the celebrated tunnel plant on the Baltimore & Ohio Railroad in Baltimore, Md.

A fine photograph of exceptional size, showing this plant, will be seen on the wall near the boilers.

The engines on exhibition will all be direct-connected with generators, with two exceptions, which will be connected by belting.

The engines will be found arranged in the following order, beginning with the engine nearest to the boilers:

The Phœnix engine (the only compound engine).
The Ball & Wood engine.
The Straight Line engine.
The Harrisburgh engine.
The Watertown engine.
The Payne engine.
The McEwen engine.
The Weston engine (belted).
The New York Safety engine (belted).
The Case engine.
The Shepard engine.
The Woodbury engine.

The exhaust from all of these heaters will be passed through a Goubert feed-water heater and then sent through the spiral riveted exhaust pipe (placed outside of the building) to a point above the roof.

All the feed-water used will pass through this heater, thus supplying the boilers with a bountiful supply of water heated to near two hundred and twelve degrees.

Two concerns share the steam-pipe covering work, one putting on Keasbey's magnexian sectional covering, while the other applies Gilmour's asbestos covering.

IN connection with the opening ceremonies of the National Electrical Exposition, when it is proposed to start the machinery by a circuit that has first looped in the whole continent, the Postal Telegraph-Cable Co., through its vice-president, Mr. W. H. Baker, has very courteously offered its fine service between New York and San Francisco for the purpose. The Postal Company has been equipping its lines with heavy copper circuits and believes that it can illustrate rapidity of working by the instantaneity of its transmission on the fourth of May, when the mere pressure of the golden key will flash the signal to the Golden Gate and back to the Exposition building in the twinkling of an eye. Arrangements are now being made with the Postal officials for the execution of this interesting plan, with the co-operation of the long string of offices scattered over the 6,000 miles of wire.

Interesting Facts in Science.

Electricity Direct from Coal.—Very little has of late been heard about the coal consuming galvanic cell. We have now a fresh communication which is certainly of a very promising kind. While engaged in experiments upon the great desideratum, a carbon anode which would undergo combustion and not the dreaded disintegration, Dr. A. Coehn found that the chief conditions to be studied are temperature and current density. When both these are duly proportioned, carbon is dissolved by the electrolyte, dilute sulphuric acid of a certain concentration, and redeposited upon the cathode. Thus the elements of a galvanic carbon cell were given. It consists of a carbon anode, dilute sulphuric acid, and a cathode of lead peroxide, and yields a steady current of an electromotive force of 1.03 volts. The actual oxidation of carbon in the cell was first studied in 1884, by Bartoli and Papasogli. These scientists obtained an E.M.F. of 0.2 or 0.3 volt only. Dr. Coehn has hence made very good progress already. The cathode of lead peroxide is, of course, objectionable, but other oxides may possibly take its place. In what state the carbon passes into solution, is not decided yet. Dr. Coehn is studying the scientific side of the problem, and will remain busy enough with his task for some time. The researches are of the highest importance. We may hope finally to settle the vexed question of the valency of carbon, and the technical development will follow.—*Elektro-technische Zeitschrift.*

EXPOSITION NOTES.

CORNELL University is among the many contributors of interesting objects at the electrical exposition. It is in possession of the Gramme dynamo built by Professor W. A. Anthony as early as 1876, and exhibited as a great curiosity at the Centennial Exposition of that year. It was probably the first dynamo of practical form constructed on those lines in this country. It was used for arc lighting and for a great variety of purposes in those early days. It has remained in use ever since, and Dr. E. L. Nichols writes that even now they are using it at the University. The art has seen many remarkable evolutions, making this machine as great a curiosity in 1896 as in 1876, and it will doubtless be a centre of attraction to all students of dynamo construction. Cornell is also exhibiting other things of interest, and its work for the success of the exposition is but natural in an institution that benefited so nobly by the first fruits of electrical invention and industry. It may be added that other very early dynamos are to be shown.

Having in mind the intense interest felt in all that pertains to Roentgen X Rays, the National Electric Light Association has arranged for a lecture on the subject during the convention next week, and has asked Mr. Max Osterberg to give it, with as many experiments and illustrations as possible. This will be brilliantly aided, of course, by the Edison exhibit, which it will in turn serve to explain. Mr. Osterberg has the subject thoroughly in hand and has accumulated a great deal of unique data and material bearing upon it. The lecture is to be given on the evening of May 5.

One of the most picturesque features of New York Harbor at night is the lane of electrically lighted buoys that marks the passage through Gedney's Channel at Sandy Hook. This is a unique installation, the current being supplied to the buoys from the shore through long runs of submarine cable. These buoys are huge spars of wood, 60 feet long, floating at a slight incline from the vertical, the lamp being carried like the head of a walking stick, and the submerged end being anchored by an iron mushroom weight. The United States Lighthouse Board has kindly placed two of these buoys, ready for lighting, one direct current and one alternating, at the disposition of the exposition management. They will be shown in a length of twelve feet, upright, and the Bishop Gutta-Percha Company has been good enough to offer runs of cable to carry current to them, of the same type as that actually supplied for the real work. These buoys will be placed near the entrance to the exposition, with charts and pictures, and the visitor will thus be able to understand how the thing works. Such an exhibit has never before been made and, as stated already, there is thus far only one such installation in the world.

In view of the importance of the occasion, the exhibit of the United States Patent Office at the National Electrical Exposition will be made one of unusual size and interest. As now arranged by the department, under the instructions of Mr. S. T. Fisher, the acting commissioner, it will include no fewer than 361 separate models of electrical devices, apparatus, machinery and appliances, many of them embodying the fundamental and elementary ideas upon which the modern electrial arts have been founded. These models will occupy over 300 linear feet, and will be carefully grouped and classified, so that students of whatever character can follow the general lines of growth or evolution.

In addition to the historical apparatus to be loaned the Exposition by Dr. R. Ogden Doremus, the following pieces of the laboratory type has also been placed at the disposal of the management: From Bellevue Hospital, Medical College, egg-shaped globe for exhibition of the electric arc in vacuo; same for exhibition of electric arc in water; Hoffman apparatus for decomposition of water. From the College of the City of New York—models showing beautifully the operation of the telephone; Erdmann galvanometer; ampere table, apparatus for development of heat by current and quantitative estimation of same; revolving Geissler tubes; Hertz mirrors; photophone; electromagnet for showing diamagnetism; rotating disk for exhibition of diamagnetism. As noted elsewhere, this will be all in more or less continuous operation.

So many important and interesting pieces of working scientific apparatus, illustrative of some electrical principle or employed in some investigation, have been placed at the disposal of the exposition management by universities, colleges and inventors, that special provision has been made for their expert care, so that they can, wherever possible, be seen in operation by the public. With this object in view, most of this interesting apparatus has now been massed into what will be known as "A Practical Laboratory," in which will be placed all pieces with which experiments or investigations of an educational nature will be made. This will enable the public to witness some striking phenomena, many of which have rarely been demonstrated hitherto outside of the walls of a college or private laboratory.

In order to give proper supervision to this laboratory the Exposition Company has asked Mr. Max Osterberg, of Columbia University, to act as its curator, and that gentleman has very kindly consented to serve. His familiarity with such apparatus and his skill as an experimenter promise a brilliant success for this novel department, which, it is said, has never been organized before at an exposition, but which realizes in a marked degree the educational purposes underlying the plans of the management.

Mr. Osterberg is now laying out the plans for showing every piece of apparatus to its best advantage. His principal aim is to have everything in such condition that the public can be made to understand some of the most difficult points in electrical engineering within a few minutes. In that way the electrical laboratory becomes a directly educational feature, and if that end is achieved Mr. Osterberg will feel amply rewarded for the trouble and care bestowed on this exhibit.

Professor Elihu Thomson is sending much apparatus which will be worked in this laboratory, and the entire working instruments of Cornell will be under Mr. Osterberg's care, in behalf of the university.

Among the special attractions will be the material kindly furnished by Prof. R. Ogden Doremus, in behalf of the Bellevue Hospital, which represents also his personal work in connection with the College of the City of New York.

Mr. Osterberg will arrange, by permission of Professor Crocker and Dr. Pupin, of Columbia University, a set of condensers to show the speed with which a message is sent through the transatlantic cables. A great many other attractive experiments are in store for curious visitors and inquiring students.

Mr. A. B. Chandler, president of the Postal Telegraph-Cable Co., has loaned the Exposition an interesting frame of very early relics of the telegraph. It contains a piece of the wire used by Morse and Vail at the Vail Speedwell Iron Works; a piece of the tape that was indented with the signals transmitting the news of Henry Clay's nomination; picture of the famous Speedwell shop—then and now—a protrait of Vail and some views of the early experimental apparatus.

A MODEL OF THE ELECTRIFIED ERIE CANAL.

UPON the request of Mr. Frank W. Hawley, who has been so actively and prominently engaged in the application of electricity to the Erie Canal, Mr. Richard Lamb, the civil engineer and inventor, whose electric bank haulage system was put in operation last year at Tonawanda, has worked out a beautiful and costly model of the whole thing; and Mr. Hawley has placed it at the disposition of the National Electric Exposition. It will be located as an adjunct to the model of the Niagara Power Plant, which is to stand in the centre of the main floor ; and the intention is to run it by some of the stored power from Niagara, switching over occasionally to the regular circuits of the building. The model is no less than 40 feet in length, six feet in height and about three feet wide. The canal will have eight inches depth of water in it. There will be eight poles, five feet apart, and a one-quarter horse-power motor will furnish a more than liberal supply of motive power to a string of three boats. The latest innovation in canal and lake freighting is the use of steel barges, and the owners of these, the Consolidated Canal Co., who now have a large number afloat, have built three small fac-similes of their craft. The model is not strictly to scale, but the boats are. Each is two feet long. They have been dubbed respectively "Hawley," "Lamb" and "Wiman." As a setting to the view of the Erie Canal with its miniature equipment of methods old and new, a scenic artist has painted an appropriate background of rural scenery. The whole thing is cleverly worked out, the "tow" going up the canal and back in about two minutes, the motor reversing automatically at each end of the section.

The Standard Underground Cable Company are determined to place themselves in a position where they can handle a contract for any character of installation with the least possible delay. For years they have been able to successfully undertake any contract for installing underground cables of high character, except conduits and rubber-covered wires and cables. Appreciating the importance of meeting every possible demand on the part of the electrical public, a large addition to their already extensive factories has been erected, and a complete modern plant for insulating wire and cables of all descriptions with rubber has been installed therein. This branch of their business has met with unexpected approval on the part of customers, and the high character of the product will undoubtedly steadily increase the output. The arrangements for testing the wires are particularly complete, and the care exercised in this department ensures the production of absolutely perfect insulation or the discovery of any faults before the wire leaves the factory.

The motto "rubber insulation with rubber in it" will appeal forcibly to those who have used many of the so-called "rubber" compounds.

The very satisfactory results which may be attained by earnest and systematic efforts to improve the quality of the manufactured article is strikingly illustrated by the character of the cables furnished by the Standard Underground Cable Company at the present time for telephone use.

A recent large order for the American Telephone and Telegraph Company, of Providence, was sold with a guarantee of 500 megohms per mile insulation resistance, and a capacity of .08 microfarads per mile. The tests of these cables by the electrician of the Providence Company disclose the remarkably low average capacity of .0743 and .0749 microfarads per mile. The highest capacity of any wire in the cable was .0776, and the lowest .0716, showing a high degree of uniformity. The insulation resistance of the wires averaged 1,933 megohms and 3,300 megohms per mile in the shorter and longer cables respectively.

The Standard Underground Cable Company, as well as the American Telegraph and Telephone Company, are certainly to be congratulated on this truly remarkable showing.

THE METROPOLITAN TELEPHONE COMPANY'S EXHIBIT.

Realizing the impracticability of adequately exhibiting the working of its complicated and extensive plant in any reasonable space the Metropolitan Telephone and Telegraph Company will make an exhibit illustrative of its New York City service as viewed from the user's standpoint. The manner in which this will be carried out involves nevertheless a more elaborate installation than might appear from the exhibit proper, as the company will place telephone stations at a number of exhibitors' spaces as well as at points where service is desired by the Exhibition Company. These stations will be connected to a switchboard in the company's space, thus forming a small exchange within the exhibition itself. This service will be furnished without charge to the exhibitors and to the Exhibition Company by the Metropolitan Telephone Company, which will furnish the entire installation and maintain the service at its own expense.

Besides the switchboard the company will install in its own space four silence booths of different types, each equipped with telephone instruments of the various styles used by New York city subscribers. These will all be working stations connected with the 38th Street Exchange and will be available to visitors to the exhibition in the same way as an ordinary public pay station.

This remarkably useful form of exhibit will no doubt be highly appreciated by exhibitors, who cannot fail to realize the convenience of being placed in easy communication with each other and with their home offices. The exhibit proper will afford the public ample illustration of the excellent service furnished by the Metropolitan Company and of the high grade of equipment provided for public and subscribers' stations.

Those visitors who display particular interest in the operation of a city telephone system will be invited to visit one of the company's large exchanges, where they can examine in detail the nature and operation of the plant, which are practically impossible of reproduction in an ordinary exhibition.

The National Underground Cable Co., of New York, Boston, Philadelphia and Chicago, has just organized a new department for the sole manufacture of Reid tubular terminal heads for electric light and street railway feeder cables and telephone and telegraph cables, said department to be under the immediate supervision of Mr. Edwin S. Reid, the inventor. The Reid terminal has done more than any other single invention to make underground cables successful, and their value is best shown by the fact that more than one hundred thousand of them are in use today in the United States and Canada on underground and aerial cables. These terminals will be used exclusively on the large contracts for underground and aerial lead-covered cables now being performed by the National Company for street railway companies, electric light, telephone and telegraph companies in Toledo, Chicago, Richmond, Philadelphia, Pittsburgh, Baltimore, Boston and San Francisco.

Mr. William Arnot, Mr. Philip Martin, Mr. Michael Duffy and Mr. John McKenna, well-known underground cable experts, have resigned from the Standard Company and have made arrangements with the National Underground Cable Company. Each of these men has had a long experience in underground and aerial cable construction work of all kinds, including street railway, electric light, telephone and telegraph cable, and are well known for their ability in their lines and are a valuable addition to the National Company's already large force.

The National Company's construction department is now one of the largest in the country, and is in a position to handle any work, no matter how large, with promptness and dispatch.

UP TO DATE.

ALL advanced and enterprising firms keep themselves posted—up to date—regarding the trade of the country. By reference to our Electrical and Street Railway Directory, containing the names of all supply houses, manufacturers, electrical engineers and experts, electricians, electric light companies, electric railway companies and everyone engaged in the electrical business in North America, you will be convinced that this book is worth a fortune to anyone selling or buying in this line. Five dollars will procure one of these valuable directories. Sent postpaid on receipt of price by The Electrical Age Publish- Co., World Building, New York.

New York Notes.

The Okonite Company have decided to move on May 1 to new offices, Rooms 412-414 of the Postal Building, 253 Broadway.

Mr. Oscanyan, a thorough expert electrician, is superintending the installation of the electrical plant at the exposition. Evans, Almirall & Co., of 41 Dey street, have the contract from the Electrical Exposition Co. The experience and ability of Mr. Oscanyan have made him a valuable aid to them in all their work, and it gives us pleasure to call attention to him.

Mr. H. T. Richards, representing the Safety Insulated Wire and Cable Co., 225 to 237 West 28th street, New York, was anxiously engaged setting up their exhibit Thursday night, April 30, during the meeting of the exhibitors at the National Electrical Exhibition. Mr. Richards believes in thoroughness in all he undertakes, using great prudence and forethought; much taste was being displayed in this exhibit of Safety wires and cables. There is no doubt this exhibit will be one of the leading attractions. Safety, indicating certainty, will insure a fine exhibit.

You are invited to call and inspect a complete and perfect automatic railroad signal system—the only electrical closed circuit system. It places the signals upon the locomotive always in view of the engineer, and giving him at all times indication of the condition of the track ahead. The danger signals indicate the nature of the danger by both visible and audible signals.

A working model of the Sheehy automatic railroad signal system is now on exhibition at Room 207, Thames Building, corner of Thames and Greenwich streets, New York. Robert Sheehy, Inventor.

Acetylene Gas.—In last number we referred to an explosion of acetylene gas which caused the death of three persons. The coroner's inquest resulted in a finding that the explosion was due to a rupture of a valve, causing gas to escape from the tank, and the ignition of the mixed gas and air.—*Trade Journal Rev.*

New Corporations.

Utica, N. Y.—The Utica Suburban Railway Co. has been incorporated with a capital of $50,000, to build and operate a street surface railway by electric power. The route proposed is from Whitesboro to Oriskany, to Summit Park on Oriskany Creek, with a branch from the intersection of Genesee street, Utica, with the Forest Hill Cemetery Road to Forest Hill Cemetery. The road is to be built this summer.

Avon, N. Y.—Avon Electric Co. Capital, $12,000; Directors, Cyrus Allen, Alva Carpenter, C. F. Whiting, L. H. Babcock, J. D. Carson and E. A. Nash, all of Avon.

Primghar, Iowa.—There is a movement on foot to connect Primghar by telephone with Sioux City, Sioux Falls and every town in O'Brien County.

Lewiston, Idaho.—P. M. Davis is preparing to construct a telephone line between Lewiston and Lapwai.

Chicago, Ill.—Office of Purchasing Commissary, U. S. Army, 250 Illinois street. Sealed proposals will be received May 14th, for furnishing telephone equipment and service. Wells Willard, Major, C. S., U. S. Army, purchasing commissary.

Mercer, Pa.—A charter was issued to the Mercer Telephone and Telegraph Co. to maintain a system of telegraph and telephone lines in the counties of Lawrence, Butler, Venango and Crawford. Capital, $20,000. Directors: George W. Wright, B. Magoffin, L R. Heath, of Mercer, and others.

Key West, Fla.—A company is being organized to put in a local lighting and telephone system. Also a trolley system about 150 miles long, to run from Key West to Biscayne Bay, on the east coast of Florida. A telegraph line will probably also be established to run four or five hundred miles north of Key West. It is expected to be ready to let contracts within the next sixty days. Address E. M. Martin, Waite Building, Key West, Fla.

Knoxville, Tenn—The local telephone companies of upper East Tennessee are organizing for the purpose of building a telephone line from Bristol to Knoxville. A meeting was held at Greeneville.

FOR UPTOWN TELEPHONE SUBSCRIBERS.

An uptown branch of the Contract Department of the Metropolitan Telephone and Telegraph Company has been established at 113 West 38th street (one door from Broadway), where all business relating to the supply of telephone service can be transacted as readily as at the main office at 18 Cortlandt street. There are 14,500 telephone stations in New York City. Metallic Circuit Service, Rapid, Efficient, Permanent, can be had from $75 a year.

TELEPHONE PATENTS ISSUED APRIL 21, 1896.

558,584. Telephone. Stephen D. Fleld, Stockbridge, Mass., assignor to the American Bell Telephone Company, Boston, Mass. Filed Aug. 24, 1895.

558,686. Telephone Trunk-Circuit. William H. Hennessey, Chicago, Ill., assignor to the American Bell Telephone Company, Boston, Mass. Filed Feb. 7, 1896.

558,859. Telephone Apparatus. Alfred Stromberg and Androv Carlson, Ill. Filed Oct. 9, 1894.

WHY THEY SOLD.

THE SECRETARY OF THE ALABAMA TELEPHONE COMPANY GIVES THE REASON.

George A. Wilkins, secretary of the Alabama Telephone and Construction Company, in conversation with a reporter of the *Journal* this morning, said in answer to a question as to why the company abandoned the telephone business in Selma: "The simple reason was that the Exchange was not paying expenses, and there was no prospect of its doing so at the prices charged. It appeared to be impossible with the instruments used, principally the Harrison, to give satisfactory service, or a service that would bear comparison with the Bell. This was a constant source of complaint and annoyance.

"It is all well enough to talk about home institutions and local influences, but the investors want and expect to receive some returns on their investment, and the people, the patrons of the Telephone Exchange, want, demand and must have good service. The prices charged and the instruments used by our company would bring neither, and this is the reason why we abandoned the field." (The Selma *Journal*, April 16, 1896.)

Possible Contracts.

EAST MARION, L. I., N. Y.—The proposed trolley road between Greenport, East Marion and Orient is being agitated. The road will be eight miles long and will cost about $150,000.

KEY WEST, FLA.—J. L.—Watrous, J. M. Phipps and E. M. Martin have applied for articles of incorporation for The Tropical Electric Co. Capital stock to be $50,000, with power to increase it to an amount not exceeding $5,000,000; to construct and operate electric light plants, electric railways and telegraph lines.

BROOKLYN, N. Y.—Stainess, Peck & Taber Co., to manufacture and deal in electric fixtures and brass and metal goods. Capital, $35,000. Directors, Charles T. Stainess of Newark, N. J.; Lewis A. Peck of Brooklyn and Thomas T. Taber of Glen Cove, L. I., N. Y.

CAMDEN, N. J.—The United States Conduit Co., to lay and construct underground conduits for electrical wires, etc. Capital $25,000. Incorporators Jacob E. Ridgway, Wm. S. Miller and Solomon S. Miller, all of Philadelphia.

ALEXANDRIA, VA.—The Painton Electric Steamship and Construction Co., to build ships to be propelled by electricity. Capital, $1,000,000. President, R. B. Painton, H. A. Solomon, secretary.

NORTHVILLE, N. Y. — The Methodist and Presbyterian Churches are considering the proposition of using electric lights for lighting purposes hereafter.

PHILADELPHIA, PA. — At a conference held April 4th at the Hotel Walton, architect Joseph M. Huston, of this city, presented the plans and a model of the Arcade, a structure nearly 500 feet square, which it is proposed to erect in New York, to contain an auditorium with a seating capacity of 25,000, to New York capitalists.

CANADIAN LETTER.

BY OUR MONTREAL CORRESPONDENT.

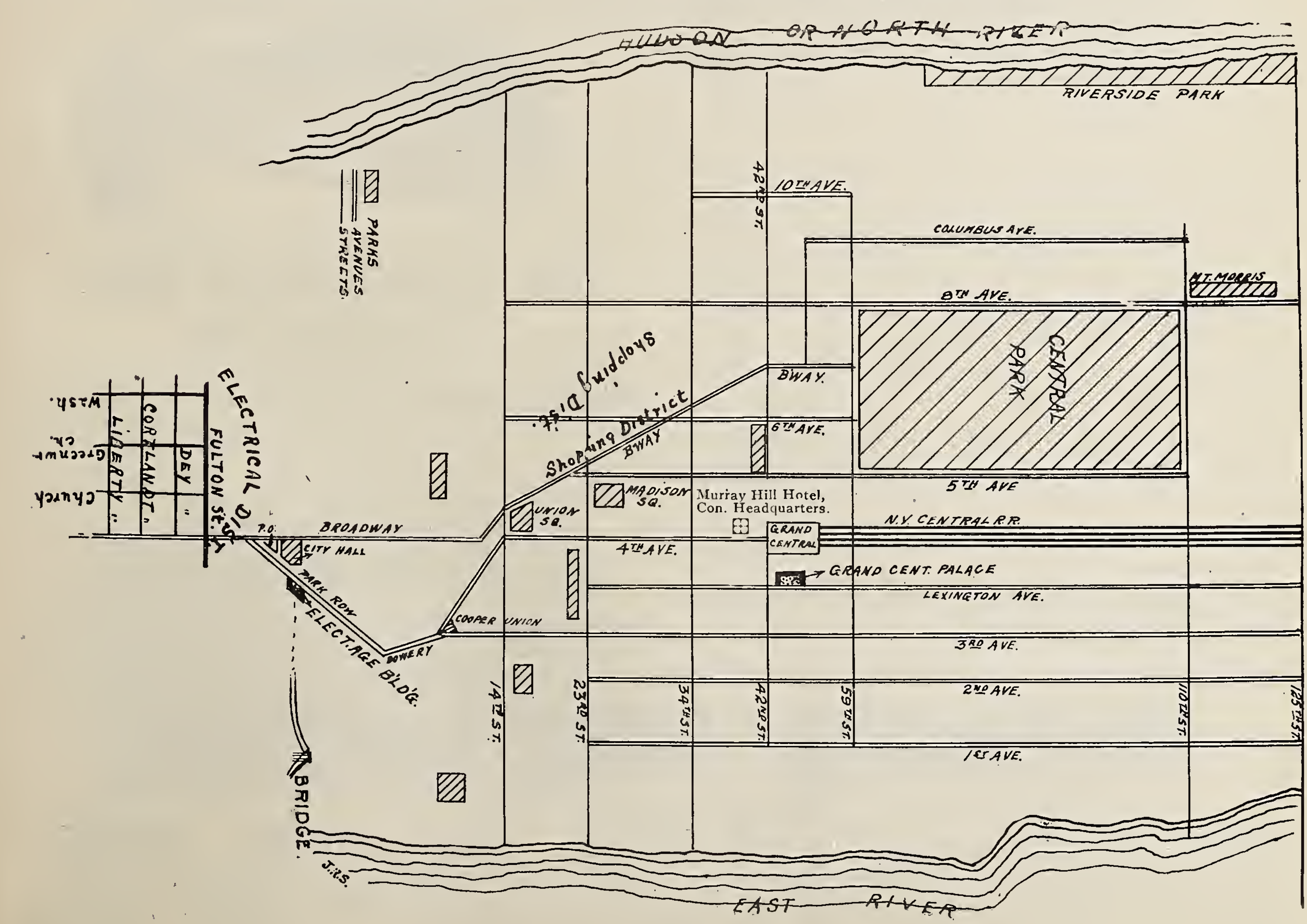
Electrical News.

SHERBROOKE, QUE.—J. E. Flood and J. W. Burke, of New York, were in Sherbrooke recently to make final arrangements with the city council and R. W. Heneker for the commencement of the electric street railway in that city.

MONTREAL, QUE.—The Canadian Electric Railway and Power Co., which propose to build an electric line from Montreal to Windsor, has had its application refused by the Railway Committee of the Dominion Parliament. Efforts are being made to restore the bill to the order paper. The promoters, who are chiefly Toronto capitalists, are George W. Beardmore and W. H. Cawthre, Toronto; James N. Osborne and Lyman M. Jones, Winnipeg.

MONTREAL, QUE.—Messrs. Hooper & Starr, the latter the well-known electrical engineer of Montreal, have commenced work on the construction of an electric railway for freight and passenger service at Cornwall. The contract for the electric apparatus, including a 200-kilowatt generator and ten G. G. E. 800 motors, has been awarded to the Canadian General Electric Company. The same company will also furnish two closed motor cars of their standard type, the balance of the cars being supplied by the Rathburn Co., of Deseronto. A freight locomotive on which the motive power will consist of four G. G. E. 800 motors with special controllers will handle the freight business between the mills and the Grand Trunk Railway.

QUEBEC, QUE.—Capitalists from the United States, including J. H. Brown, Baltimore, president of the Maryland Trust Co.; J. Shear and W. J. McCracken, New York, and F. O. Blackwell, C. E., are interested in the Quebec Electric Street Railway scheme.



CONVENIENT MAP OF NEW YORK CITY FOR VISITORS.

ELECTRICAL and STREET RAILWAY PATENTS

Issued April 21, 1896.

558,480. Apparatus for Electrically Working and Welding Copper. George D. Burton, Boston, Mass. Filed Aug. 11, 1893.

558,491. Electric Street-Car Motor. Samuel Harris, Cleveland, Ohio, assignor to the Steel Motor Company, same place. Filed Feb. 10, 1896.

558,506. Printing-Telegraph. Benjamin F. Merritt, Newark, N. J., and John M. Joy, New York, N. Y., assignors to the Consolidated Telegraph and News Company, New York, N. Y. Filed June 29, 1895.

558,507. Automatic Governing Device for Motors. Benjamin F. Merritt, Newark, N. J., and John M. Joy, New York, N. Y., assignors to the Consolidated Telegraph and News Company, of New York. Filed June 29, 1895.

558,509. Wire-Clamp for Telegraph or Similar Wires. George Middleton, Kirkwood, N. J. Filed July 31, 1895.

558,517. Regulator for Electric Motors. Oscar H. Pieper, Rochester, N. Y. Filed Jan. 20, 1896.

558,518. Handle for Circuit-Breakers. William B. Potter, Schenectady, N. Y., assignor to the General Electric Company, of New York. Filed Jan. 15, 1896.

558,538. Car-Fender. William Waegel, Philadelphia, Pa. Filed Aug. 8, 1895.

558,539. Core for Electromagnets. Addison G. Waterhouse, Hartford, Conn. Filed Oct. 16, 1894.

558,555. Electric Guest-Call. Simon K. Gimbel, Vincennes, Ind. Filed Dec. 12, 1895.

558,559. Electric Rheostat or Heater. Harry W. Leonard, East Orange, N. J. Filed Dec. 18, 1895.

558,564. Electric-Alarm System. Charles A. Rolfe, Chicago, Ill. Filed Sept. 24, 1894.

558,565. Railway-Signal. William G. Roome, Jersey City, N. J. Filed Nov. 17, 1893.

558,566. Railway-Signal. William G. Roome, Jersey City, N. J. Filed Nov. 17, 1893.

558,573. Apparatus for Detaching Electric-Lamp Bulbs. Oleny Smith, Detroit, Mich. Filed Oct. 7, 1895.

558,585. Electric Metering System. John W. Gibboney, Lynn, Mass , assignor to the General Electric Company, of New York. Filed Mar. 6, 1895.

558,602. Electric Signal for Railway-Trains. Edward J. Devine, Schreiber, Canada. Filed July 25, 1895.

558,609. Drop-Light Electrolier. George Peeples, Philadelphia, Pa., assignor of one-half to the Thackara Manufacturing Company, same place. Filed Dec. 24, 1894.

558,617. Telegraph-Key. Walter E. Simons, Dublin, Canada. Filed Sept. 12, 1895.

558,634. Electric Glow-Lamp. Edward A. Colby, Newark, N. J. Filed May 21, 1894.

558,650. Means for Controlling Electric Currents. Patrick Kennedy, Brooklyn, N. Y. Filed June 27, 1895.

558,659. Life-Guard for Street-Cars. George A. Parmenter, Cambridge, Mass. Filed Nov. 4, 1895.

558,672. Relay. Frank E. Chapman, Medford, Mass. Filed Jan. 27, 1896.

558,687. Apparatus for Operating Electric Switches. Daniel Hinchliffe and Alton D. Edes, Plymouth, Mass. Filed May 15, 1895.

558,692. Method of Manufacturing Electrodes for Secondary Batteries. Isidor Kitsee, Philadelphia, Pa. Filed Nov. 8, 1894.

558,711. Car-Fender. Walter Batten, Brooklyn, N. Y. Filed July 3, 1895.

558,714. Electric Heating. Charles S. Bradley, Avon, N. Y. Filed Aug. 22, 1891.

558,717. Process of Electrically Treating Fabrics for Water-Proofing or Other Purposes. Henry L. Brevoort, Brooklyn, N. Y.; Gertrude L. Brevoort, executrix of said Henry L. Brevoort, deceased, assignor by direct and mesne assignments, to the Electro-Waterproofing and Dye-Fixing Company, New York, N. Y. Filed July 1, 1890.

558,724. Device for Regulating Motive Power. Bradley A. Fiske, U. S. Navy. Filed Sept. 10, 1888.

The Electrical Age.

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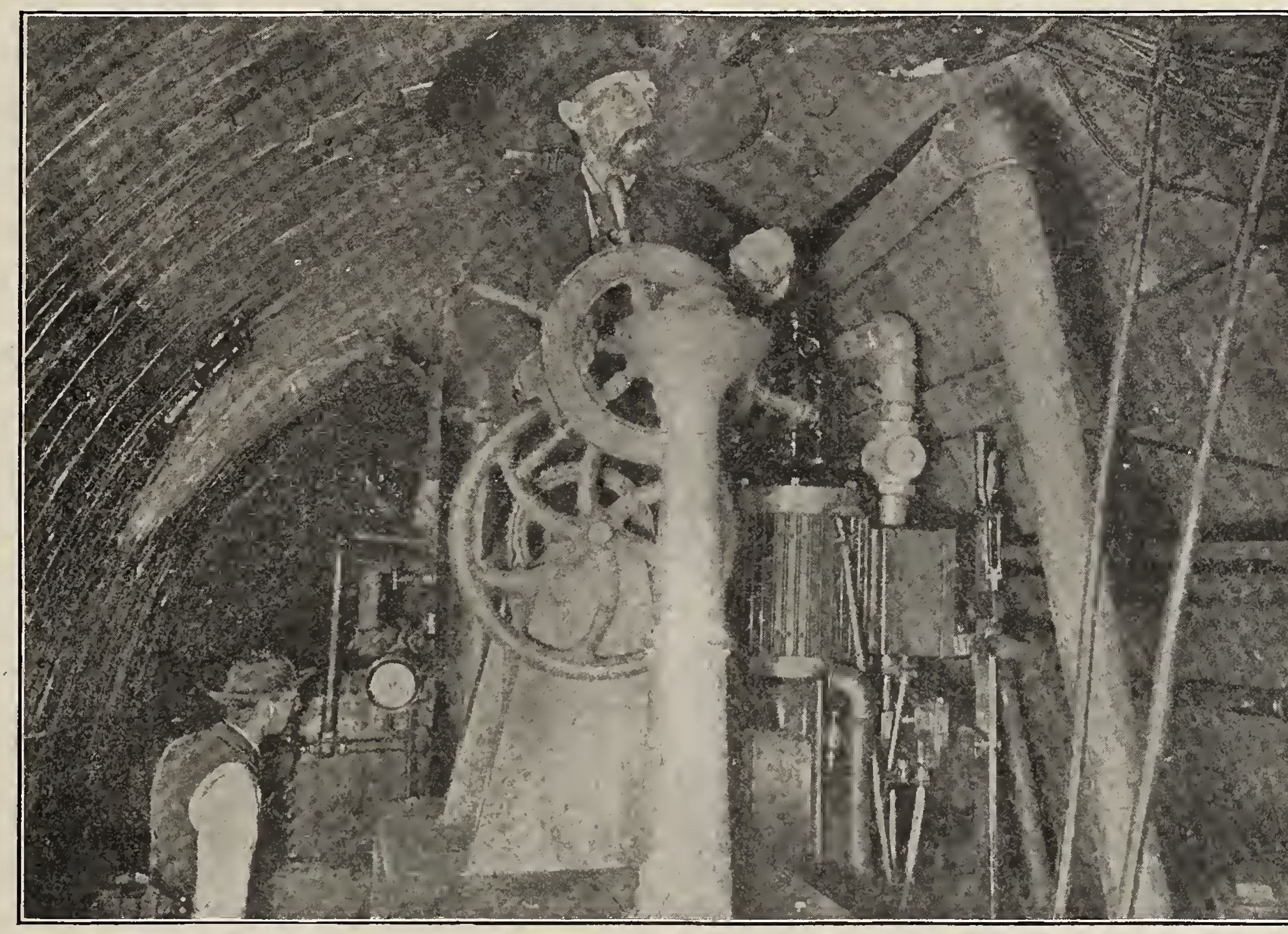

INTERIOR OF TORPEDO BOAT.

PRINCIPLES OF DYNAMO DESIGN.

BY

Newton Harrison E.E.

(*Continued from page*) 222.

Of the many miscellaneous applications of electricity to art and medicine, there is but little to be said. It is not strange that the developments have been many, for in no

ON THE SURFACE.

case has the field been so quickly covered by any other applied science. In mining, to which but passing reference has been made in lighting, in which it found its most fruitful soil and in the myriad of unique departments calling for its use, it has supplied at once the long-felt necessity. To speak of the sum invested in telegraphy, telephony, railroading and electric lighting today would be of no interest ten years from now.

We are prepared to expect the most prodigious strides—a progress that will not allow of defined limits. Electrolysis and mining are almost identical departments of applied electricity, yet they differ. The production of ore and the refining or smelting of it constitute the most distinguishing features. Of late the general use of water-power has made mining a field of industry that bids fair to develop beyond its present condition to an enormous extent. A mountainous district is usually well supplied with water-power; either a stream of great head or a heavy flow of slight fall. Both are equally useful in turning the dynamos supplying the current to the mine. It may be used either for lighting, or metallurgy, or the running of short lines of cars for local use. Another peculiar application is to the naval service—the equipment of torpedo boats. Either a storage battery outfit is put on board to run the motor, or it is controlled by a flexible line from the vessel. It is not the purpose of the writer to more than touch upon the more important application of motors and dynamos in a general manner.

Torpedo boats.—The naval service has been receiving many valuable acqusitions in the shape of the above-mentioned submarine boats and electric cutters or launches.

The evident tendency is to make none other than the most practical experiments with the usual result of adopting some useful contrivance of great value. Were the inventive power of some minds inclined to the development of warlike equipments, there is no doubt that the most deadly armaments would be evolved.

In the general survey of these problems a great deal of useful information is to be found in a volume by Martin and Sachs on electrical navigation. The requirements are such that the greatest skill is necessary in order to secure a fast, light and well designed vessel About 15 knots an hour on the surface and 8 to 12 knots when submerged, capable of 30 hours' continuous run, of turning in a circle not exceeding four times her length in diameter, and of rapidly rising or sinking, are some of the demands made on her designer. The walls of the boat must resist a heavy pressure and the compartments must be so constructed as to allow of a supply of air sufficient to last from 10 to 15 hours.

Many interesting points relating more to the boat than the motor are worthy of attention, as the problem is thus presented in a general light, which is much more useful to the designer than one limited view of a particular part with its rigid limitations.

The navy department assigned to the greatest displacement the value of 200 tons, when the vessel is below.

Curious to relate, the torpedo boat designed by Lieut. Hoogaard was supplied with a double equipment. Engines capable of developing 600 indicated horse-power were used when on the surface; but during submersion a motor of 35 H. P. capacity was to be used, supplied with current from a storage battery; its speed then being about six knots for five hours' run.

The ascension of the vessel was brought about by a five H. P. motor, which actuated a vertical screw. Water ballast was provided with a pumping apparatus to discharge it all in about half an hour. Primary batteries have been used in this work. According to the authors from which we quote, the French ordered the construction of a boat to be run by primary batteries, to be about 15 feet long, five feet in diameter, and to be driven by an electric motor as well as illuminated by power derived from this source. The Baker, designed by an American, is a storage-battery boat of 75 tons displacement, built of wood and with a shell six inches thick. The wood is oak and will stand by its peculiar bracing an enormous pressure. The method followed out is very interesting. The boat contains a steam plant, the engine of which runs a dynamo when the boat is on the surface. The storage cells are then charged and the boat is ready for submersion if necessary. When this is to occur the fires are put out, and the current used to run the dynamo as a motor and thus drive the boat by its attached screw.

The illustration shows the inside of the turret, in which the pilot stands, as well as other sketches relating to the vessel. A 35 H. P. engine and a 60 H. P. boiler, a 50 H. P. motor and ten tons of storage batteries complete the outfit. The motor runs at 200 volts pressure with 900 revolutions per minute. The cells equal 232 in number and are grouped in lots of 58 each. The boat carries two men who, without inconvenience, have remained in her under water about three hours. Many other interesting cases might be cited to show the unique and most excellent means of applying the motor or dynamo, not only to ordinary purposes, but to those in which in a sense the welfare of the nation is concerned.

(*To be Continued.*)

Fly-wheel Calculations.—It is frequently desirable to ascertain whether a certain fly-wheel is heavy enough for its work. A practicable off-hand method of ascertaining this point is to divide the constant 5,000,000 or 6,000,000, according to the speed of the wheel, by its diameter; that is, if a wheel is running very fast, use the constant 5,000,000; if it is running slow, use the constant 6,000,000. After dividing by diameter of the wheel, divide it again by the square of the number of revolutions per minute. The quotient will be the number of pounds weight of rim required in each horse-power, and from these data the size of the wheel necessary can be readily calculated.—*Tradesman.*

THE COMMERCIAL VALUE OF ACETYLENE GAS AS AN ILLUMINANT.

BY LOUIS A. FERGUSON.

IT is my intention in presenting this paper to treat of acetylene in its commercial aspect as related to the illuminating industry, and to attempt no description of its value in the chemical world, as the latter is a field entirely apart from that invaded by this association, and one so comprehensive that it might well be made the subject of another discourse.

The first step in the process of manufacture of acetylene gas is the production of calcium carbide, which is accomplished by the reduction of lime by carbon with the intense heat of the arc in an electric furnace. The chemical equation representing the action is $CAO + 3C = CAC_2 + CO$, the CAO representing the lime, 3C the carbon, CAC_2 being the symbol of calcium carbide, and CO_2 carbonic monoxide. Although several experimenters produced carbide of calcium and carbide of sodium, and from these acetylene gas, many years ago, the first production of carbide of calcium on anything like a commercial scale was made by Mr. T. L. Willson at Spray, North Carolina, while endeavoring to produce the metal calcium in the electrical furnace. It was my good fortune to have visited with Mr. Willson his plant at Spray, and there carried on experiments in the manufacture of the carbide of calcium and the production therefrom of acetylene gas, and perhaps a few words in description of the apparatus employed may be of interest to you.

Spray is a beautiful little spot about twenty-five miles southwest from Danville, Va., and about two miles from Leaksville, North Carolina. It is reached from Danville by a narrow gauge road, operated by the negroes, the locomotive boiler being fired by wood in true primitive fashion, the roadbed hardly being the equal of the trunk lines between New York and the West. The carbide plant is located alongside of a small stream which has quite a fall at this point, the power of the fall driving a Leffel water-wheel, to which are belted two General Electric Company's 120 k. w. alternating-current dynamos built for sixty cycles per second. In Mr. Willson's original work he used a direct-current dynamo of his own construction, but this was abandoned later and the larger alternating-current machines pnrchased, so as to enable the experiments to be carried on upon a larger scale. It was also imagined that an alternating-current dynamo would give better results, it being claimed that the alternating current would keep the mixture of coke and lime stirred up about the arc. This, of course, was a fallacy, the real value in the use of the alternating-current machines as compared with the original ones built by Mr. Willson lying in that, no commutator being required, it was much easier to regulate under the varying conditions of the arc, and there was an entire absence of sparking, which was a destructive feature of the original dynamo. The alternators are built for 1,000 volts, arranged to run in parallel, and transformers are used to bring the pressure to 100 volts. The switchboard for the dynamos is provided with ammeters and voltmeters for each dynamo, so that the output may be accurately determined. From the switchboard large cables, capable of carrying 1,000 amperes, run to each of two furnaces, see Fig. I., which are built of brick, the dimensions of the furnace being approximately three feet square and eight feet high.

Each furnace is provided with a flue fo carry off the gases of reduction. In the floor of each furnace is a carbon plate to which the cables connect, this plate constituting one pole of the arc. The upper carbon for the arc consists of six carbons in one cast-iron holder, each being four inches.

(*To be Continued.*)

THE EVOLUTION OF THE ARC LAMP.

L. H. ROGERS.

FOR the purpose for which it is intended to be used the arc lamp, as we commonly know it, is mechanically and electrically, the poorest designed and constructed piece of mechanism on earth.

The author of such a statement could only conscientiously proclaim it upon such an occasion as this, before a body of men who are thoroughly familiar with arc lamps, who can instantly spot the first sign of a lack of logic in the argument which must necessarily follow such a radical statement.

Washington was still alive when Volta, a Frenchman, discovered the energy displayed in the consumption of certain metals when immersed in acids. It was simply impossible for him to have realized at that time what the invention or discovery of a primary battery meant.

A few years after this, in 1802, Sir Humphry Davy connected up a large number of Volta's cells. He connected the positive of one cell with the negative of the next one, the positive of that with the negative of the next, and so on. After connecting about 2,000 cells together thus, in series, he attached a piece of charcoal to the positive of one end of the line, and another piece of the same material to the negative of the last cell in the row. Then, first touching the pieces of charcoal together, and afterwards drawing them slightly apart, the first arc lamp was produced. The pieces of charcoal were in a horizontal position, and as the heated atmosphere between the points caused the flame, or mass of illuminated particles, to bend upwards in the form of an arch, the name of "arch" light was given to this new form of illuminant.

This term has since been changed to "arc."

History gives us no information regarding the importance attached to Davy's new light, by his neighbors, his wife, or even his scientific associates. It is more than probable that all of them looked upon him as a cranky old professor, foolishly wasting his time and money.

Certain it is that it was utterly out of the question for anyone of that time to imagine that, before the close of the century, Davy's light would become the commercial light of the world.

In fancy, I lead Davy through the city of Philadelphia, with her streets illuminated by 6351 arc lamps—the best lighted city on earth—and try to catch some conception of his thoughts, as he realizes what his two pieces of charcoal have done for mankind.

It requires 1896 to appreciate 1802.

Some one has said that Faraday was the greatest discovery of Davy's. It must have been that Davy's teachings found good and fruitful soil when instructing his youthful pupil.

It was in 1832, three years after the death of Davy, that Michael Faraday discovered the principles of electromagnetic induction.

This was a giant stride in the ultimate development of the arc lamp, for the reason that by the applications of these principles the modern dynamo was born. What Faraday did for the world can better be understood if we can imagine primary batteries of equal capacity and power, in lieu of all the dynamos now used for arc and incandescent lighting. The contemplation is sufficient to cause us to love Michael Faraday.

In place of the large number of troublesome and cumbersome cells, the electric potential or energy necessary to maintain an arc between the two pieces of charcoal was now generated mechanically, rather than chemically, with one piece of machinery, rather than a large number of acid-slopping jars.

(*To be Continued*).

Interesting Facts in Science.

Japanese Swords.—The most famous sword maker was Masamune (about A. D. 1290); and, next, his pupil, Muramasa (about 1340); then Yoshimitsu (about 1275), and Munechika (990). Of Musamane's swords it is often said that they are so fine they will cut a hair falling in the air, or cut in two the very hard skinned adzuki bean as it falls; or, if held in a stream, will cut in two a sheet of paper floating down. The swords of Muramasa are said to be so finely tempered as to cut hard iron like a melon. The first reported human swordsmith is said to have been Amakuni of Uda, in Yamato (about 60, B. C.); but the oldest known swords, some of them still extant, were made by another smith of the same name and place, about A. D. 702. The Emperor Gotoba (1184) greatly favored the art of sword making, and even practiced it himself. In general the art flourished in times of many wars, particularly in the thirteenth and fourteenth centuries, the age of the best swords. For the past 300 years of peace mainly, skill in sword making has declined. Old swords, so-called, date from before that time, that is, before 1603.—*Iron Age*.

Electrical Life-Buoys.—An ingenious application of electricity to life-buoys is given by an American contemporary. A buoy is mounted on a metal frame which carries dry accumulators or batteries and an electric light. When the buoy is thrown into the water the flotation of the buoy automatically operates a switch, which brings the battery into action and controls the light. The batteries are waterproof, and the electric contacts are so arranged that a very small movement of the buoy will close circuit and light the lamp, but to break the circuit and put the light out the metal ring has to be revolved nearly one complete revolution, which insures the continuity of the light in rough sea.—*Trade Journal Review.*

Oldest Engine in the World.—An old Newcomen engine near Bristol, England, is perhaps the oldest steam engine now running. It seems to have been built about the year 1745, according to *Engineering*, and is still employed about five hours a day for pumping water from a coal-pit. The cylinder is 5½ feet in diameter and the piston has a stroke of six feet. The engine has a beam twenty-four feet long and about four feet deep, built up of many oak beams trussed together, and works with a curious, creaking noise. The total weight is about five tons. Steam is now taken from some boilers in a neighboring establishment, the pressure being reduced for this engine to two and one-half pounds. The indicated horse-power is only 52¾. The old man who attends to the engine has driven it since he was a boy, and his father and grandfather worked it before him.—*The Tradesman.*

Black Polish on Steel Needles.—Mr. Herman Nobis, of Berlin, covers steel needles with a black coating which takes a polish in the following way:—The needles are cleaned of grease and any oxide and first dipped into a bronze bath. Twenty grammes of sulphate of copper are dissolved in hot water and filtered; 15 grammes of stannous chloride and 20 of hydrochloric acid are then added, and the solution is diluted to one litre. The liquid becomes turbid and a whitish sediment forms; in this state it is ready for use and can be kept for several days. The needle remains only 10 seconds in this liquid, is then rinsed with water and put for two or three minutes into another solution containing 1.5 kilogramme of sodium hyposulphite, 75 grammes of hydrochloric acid and one kilogramme of water. The hypo salt is dissolved warm, filtered through cloth and mixed with the acid; the liquid becomes yellow and turbid and is, after a few minutes, poured through a fine wire sieve. The solution remains good for two hours and can be renewed by adding fresh hydrochloric acid, after which it has to be refiltered. The needles are finally washed in water and dried. The process is patented.

SINGLE-PHASE SELF-STARTING SYNCHRONOUS MOTORS.

BY F. H. LEONARD, JR.

EVERY central station manager who operates an alternating plant has to grapple with the question of power distribution. Applications for power service come in from every direction, and in many cases, properly worked up, would make a more remunerative business than that of furnishing current for lighting purposes. It is, perhaps, unnecessary to point out that the bulk of the lighting service averages but a few hours per day, whereas the motor service covers a much longer period, with a corresponding reduction in cost of the current output. The difference is so great that many stations are furnishing current for motor service at 50 per cent. of the price for lighting service, and, even then, figure that the motor business is the more profitable.

To secure this business and meet the demand for power service, many of the alternating stations have installed special 500-volt direct current generators and erected additional lines; but such a system is limited by the expense of such extension, necessarily paralleling other lines already constructed for lighting service. Under such conditions, a remunerative piece of business is often refused on account of the first cost of the extension necessary to reach the customer.

The many advantages of the single-phase alternating current system have led to its adoption in the great majority of the central lighting stations of the United States, notwithstanding the objections that (aside from a few inefficient fan motors of a fraction of a H. P.) no motors practical for general power distribution were obtainable for use on this system. This objection, however, no longer obtains, as there are alternating current motors now made to operate on the single-phase circuits for ordinary lighting transformers without the use of special starting devices, condensers or connections, which not only equal the best direct current motors in commercial efficiency, but are superior to them in point of regulation, reliability and freedom from burn-outs. With such a motor, which can also be used as a rotary transformer, the single-phase alternating system has every advantage of the low tension direct current system, besides which it is much superior in simplicity, flexibility and adaptability for long distance distribution. So that to-day arc and incandescent light, heat and power are distributed from the alternating system at a distance of a fraction of a mile, or at thirty miles or more, controlled, regulated and metered with equal facility and perfect satisfaction to the customer.

The single-phase alternating current motor has been to the electrician like the panacea of the alchemist, the cause of almost endless thought and experiments; but the solution of the problem was a most simple one and rests on two well-known principles. Attempts have been made to use induction motors on the single-phase circuits, but it is difficult to stop them, and usually very cumbersome and expensive arrangements have been devised which give but small starting torque. Besides this, to make them at all efficient and keep the power factor within reasonable limits, a very small clearance or air gap (often as little as one-quarter millimeter or one-hundredth of an inch) must be allowed between fields and armature, so that the slightest mechanical wear or vibration causes trouble. Even under the most favorable conditions it is impossible to construct an induction motor so as to avoid a very considerable lagging or so-called "wattless current."

(To be Continued.)

Cost of Power.—From figures quoted by Professor Crocker, an electrical horse-power costs $48.68 per annum, when developed steadily, and $117.78 per annum with a variable load similar to that of an electric light station.

THE W. J. HAMMER HISTORICAL COLLECTION OF INCANDESCENT ELECTRIC LAMPS.

This collection of incandescent lamps, to be shown at the Exposition, represents to a very considerable degree "The History of an Art." It starts with original models exemplifying the early laboratory work of such men as Chaugy, Lodyguine, Edison, Sawyer & Man, Swan, Lane-Fox, Maxim, Weston and others. In many cases these inventors and experimenters are represented by numerous forms of lamps showing in a most interesting way the development in the art as their knowledge and experience increased. To these must be added the following, who are among the many represented in this wonderfully interesting collection, and who by their work have contributed to the development and practical application of the incandescent electric lamp: Miller, Diehl, Siemens & Halske, Siemens Bros., Rogers, Gatehouse, Crookes, Boehm, British Electric, Duplex, Bernstein, Pray, Van Choate. Thompson, Thomson-Houston, Shaefer, Opperman, Vitrite-Luminoid, Novac, Woodhouse & Rawson, Excelsior, Baets, Greiner, Reinmen, Richter, Green, Latimer, de Khotinsky, Goebel, Packard, Stanley, White, Westinghouse, Hammer, Jenny "D. A. C.", Perkind, Cruto, Shultzberger, Sunbeam, Fitzgerald, Franklin, Moses, Kurtzgen, Aleester, Alexander, Gerard, "A. B. C.," Sun, Seal, Remington, Heisler-Bernstein, Victoris, Mather, Swan-United, Edison-Swan, Brush-Swan, etc.

This remarkable collection has been gathered from many quarters of the globe—America, England, France, Germany, Austria, Italy, Holland, Switzerland and other countries contributing. Mr. Hammer started the nucleus of it at Mr. Edison's laboratory in Menlo Park, where he was an assistant in the early days of Edison's work upon the incandescent lamp. Having charge of and assisting in many of the original experiments, tests, records, etc., he made a practice of collecting, with Mr. Edison's permission, certain lamps showing important steps in the work, believing they would some day be of great interest and value. Subsequently Mr. Edison gave him nearly all the lamps he had, which now form an excellent record of his work. To these, Mr. Hammer has added from time to time during the past seventeen years. As five years of this period were spent in Europe, he secured many most valuable examples of the early lamps of the foreign inventors. Mr. Hammer also exhibits the only collection in existence of the early substances Edison tried in his endeavors to secure a practical filament for the incandescent lamp.

A striking figure in the intellectual development of New York throughout the last half of the century has been Dr. R. Ogden Doremus, of the College of the City of New York, Bellevue Hospital and other prominent institutions. He has always taken an active part in the advance of electricity as a section of the domain of physics and chemistry, and is manifesting a deep interest in the National Electrical Exposition. In spite of pressing duties he has, with the aid of his son, Prof. C. A. Doremus, gathered together some of his more interesting apparatus, and is contributing a display which, after all, is but the merest fragment of what might be shown and which is exclusive of the working apparatus to be placed in the "Practical Laboratory." It includes, for example, Henry's own experimental induction coil; the famous "Tithonometer" devised by Prof. J. W. Draper in 1842; a "Titionotype" or copper electrotype of a daguerreotype, and a daguerreotype taken by the Doctor in 1844; electrolytic marsh apparatus made by Dr. Doremus in 1860; a quantity battery of which the carbons were obtained from iron gas retorts in 1854, each weighing 90 pounds. There will also be two large prisms, 9 inch aperture, for rejection of the spectra of metals, each holding 10 pounds of bisulphide of carbon.

Sandwich, Mass.—The local telephone connection will be extended this spring to Sandwich.

C. R. Huntley, Ex-Pres. 1891, N. E. L. A.

T. Prentiss, Brush Elec. Company.

C. O. Baker, Jr., Chair. Transportation Com.

S. M. Hamill, V.-Pres. Brush Elec. Co.

Elihu Thomson, Gen. Elec Co.

Edwin J. Houston, Author and Expert.

H. H. Brooks, Am. Cir. LoomCo.

F. S. DeRonde, Standard Paint Co.

A. Kennelly, Author and Expert.

E. H. Johnson, Pres. Interior Conduit Co.

W. A. Rosenbaum, Patent Expert.
W. L. Candee, Okonite Co.
J, S. Speer, Sec. Partridge Carbon Co.

F. Nicholls, Pres.-Elect of N. E. L. A.

C. H. Wilmerding, Ex-Pres. N.E.L.A.
H. J. Smith, Pres. Exposition Co.

E. F. Peck, Mem. Exec. Com. N.E.L.A.
C. D. Slain, Siemens & Halske.

A. D. Chandler, Electrical Expert.
J. A. Seely, Mem. Exec. Com. N.E.L.A.
H. L. Sluppy, Roebling Sons & Co.

ROENTGEN RAYS.

How they were discovered.—Professor Roentgen came upon his discovery quite by accident. He was experimenting in the dark with a Crookes vacuum tube which was covered with some sort of cloth. A strong electric current was passed through it, while close by there was some prepared photographic paper, but no camera. On this paper the professor noticed next day several lines for which he could not account. By restoring exactly the circumstances as they existed on the preceding day he was able to ascertain the real origin of these mysterious marks. He continued his experiments with the Crookes tube and photographic paper, and found in the first place that not only may a camera be dispensed with, but that the image from the light rays of the Crookes tubes is not obtained if it has to pass through lenses.—*Current Literature.*

Features of X Rays.—To thoroughly understand the deep interest attached to X-ray work and its bearing upon the present theory of light the most striking facts are noticeable, as follows:

(1.) The rays are not repeated. It is understood that this phenomenon is explained by the definition—"Refraction is the deflection or bending which the rays of light experience in passing obliquely from one medium to another."

(2.) They develop no heat.

(3.) They move forward in straight lines.

Sealing Bottles by Electricity.—M. Villon accomplishes this by covering the cork and part of the neck with a thin layer of copper electrically deposited. For this purpose the neck of the bottle is coated with a conducting substance such as blacklead, zinc, or copper powder, and plunged in a plating bath. The deposit may be gilt or silvered afterward to any shade.

The First Telephone.—It seems that Dr. Cushman invented the telephone in 1851. He placed an arrangement on the ground to use as a lightning arrester, very similar to the modern receiver. A thunder-storm came on one day and the apparatus at Racine enabled them to hear the croaking of frogs at the station thirteen miles away.

Phosphorescence.—This was first observed in 1604 in Bolognese phosphorus (sulphide of barium) but it also exists in a great number of substances. The sulphides of calcium and strontium are those which present it in the highest degree. When well prepared, after being exposed to the light, they are luminous for several hours in darkness. But as this phosphorescence takes place in a vacuum as well as in a gaseous medium, *it cannot be attributed to chemical action, but rather to a temporary modification which the body undergoes from the action of light.*

The Best Phosphorescents.—The order in which the following substances are placed display their power to fluoresce: diamonds, especially yellow ones; fluorspar, arragonite, calcareous concretions, chalk, apatite, heavy spar, dried nitrate of calcium, etc. Besides these, such substances as dry paper, silk, cane sugar, milk sugar, etc. become phosphorescent by isolation.

Thirty-Seven Miles Above the Earth.—In air at a pressure of 62 mm., which corresponds to an atmospheric height of 12 4 miles, the electric discharge has the carmine tint so often seen in the display of the aurora borealis; at a pressure of 1.5 mm. corresponding to a height of 30.96 miles, it is a pale white. Under a pressure of .379 mm. the discharge has the greatest brilliancy. This represents a height of 37.67 miles, and would be visible at a distance of 585 miles; it is probably the upper limit of the height, though on the other hand it is possible that the discharge may sometimes take place at a height of a few thousand feet.

White Plains, N. Y.—It seems probable that the trolley road from White Plains to Mamaroneck will be built at once.

INQUIRY COLUMN.

In this column we shall endeavor to answer all questions relating to the science of electricity that may arise in the minds of our subscribers.

(*Q.*)—**College of Electrical Engineering.**

To Editor of Electrical Age.

Kindly advise me through the columns of your esteemed paper of a number of colleges where electrical engineering is taught and the requirements for admission to same.

Respectfully Yours,
Wm. Heymann.

(*A.*)—There are such colleges as Columbia, Cornell, Harvard, Yale, Johns-Hopkins University, etc., which teach the science of electricity. The requirements are generally a knowledge of English, German and French, arithmetic, algebra, geometry and trigonometry, physics, chemistry, geography and mechanics.

Each college has its characteristic studies; the above being the most common for entrance. The best equipped in the East is Columbia University, presided over in its electrical department by Professors Crocker and Pupin. Write to the Registrar's office, School of Mines, Columbia University, 49th street and Fourth avenue, for further information.

(*Q.*)—**A Continuous-Current Machine.**

Dear Editor:—Kindly inform me in the inquiry column whether a dynamo exists which produces a perfectly continuous current. The ordinary machine gives one, which is undulating in its character. Is there such a machine as that of which I speak?

(*A.*)—The machine of which you speak does exist. It is one of the earliest types, called the disk or unipolar dynamo at the present day. The current flows from it in an uninterrupted stream. It has no superior for the production of heavy currents by a simple means.

(*Q.*)—**Light.**

New York, April 6, 1896.

Mr. Editor:—In contemplation of some of the wonderful properties of light and the striking *individuality* of its rays, if the phenomenon may be so termed, the writer experienced a sense of awe in reflecting upon the singular fact that, for instance, the light emitted by a tiny star in the zenith is transmitted in tact in the broad glare of day and may be seen at the bottom of a well or mine, notwithstanding the fact that its little pencil of light traverses the entire stratum of the sun's rays in our atmosphere. Perhaps some of your readers can explain why the identity of that little pencil of light is not lost or merged as a rain drop would be in the vast ocean? P. A. McG.

(*A*).—The explanation to be given of so interesting a phenomenon is really wonderful in itself.

Rays of light are impulses set up in the luminiferous ether, and are directly due to a force applied at a given point or succession of points thus manifesting itself. A beholder at the bottom of a deep mine is comparable in imagination to a spectator transported to a point in the heavens from which all light has gone and darkness preponderates. The centres of disturbance from which spring these effects called light are then seen to be widely scattered. The vast gaps between each blazing orb gives room for the streaming rays; the light may fade with the increasing distance, but each quivering particle of ether must and will leave its impress upon the eye's retina—each swiftly passing wave, however far, moves onward to the vast confines beyond—each in its single, silent way with fast diminishing splendor, each seen dimly shining amongst the glorious constellations of the night, and only viewed again from some dark spot where its presence may be at once perceived amidst the solar glory.

Marquette, Mich.—The Marquette County Telephone Company will soon begin the construction of a metallic circuit in its line between Ishpeming and Marquette.

The Electrical Age.

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CONTENTS.

A CONVENTION OF ENGINEERS.

The representatives of numerous manufacturing firms met in session on the dates of the convention meetings of the National Electric Light Association. Several important papers were read of an instructive and novel nature bearing upon the problems of the day, and having reference to certain imperfections which have been characteristic of several types of apparatus. It is not entirely our object to criticise these articles, but to consider in common with other features of the Exposition the importance and usefulness of convention meetings at such places. There is a clannishness among professional men which early exhibits itself in other similarly classified arts. The branches of industry, especially electrical, are not so well occupied nor so controlled that the bitter rivalry seen in many other cases rises into open sight. It is a triumph to business men if they can compete in their different vocations; if they can play their games of finance with the same spirit of forbearance that they would the innocent games of home and hearth. There is, indeed, more than a trifle of mutual appreciation shown by the good fellowship and frank courtesy of convention members. The understanding that such meetings are for the common good prevails to a marked extent. Those that have fostered new ideas ventilate them with a freedom that calls forth appreciative criticism and helps to evaluate their worth without delay.

Thus it seems conventions succeed in two respects: In promoting a scientific tendency and in assisting to an extraordinary extent to develop the social element with all its fruitful signs of successful good fellowship. The gentler sex, with their limited chances of travel, look upon the convention with a sense of supreme delight. It fully satisfies their love of change and gives them a chance to see their husbands or relatives' friends and judge of their admirable qualifications.

The papers of the convention sessions, which contributed their share to the success of the meetings, were delivered by able and experienced men. All are well known to the fraternity and therefore received the attention which such efforts merited.

What will be the newest at the next convention? What novel application will show us the blood coursing through our veins, the heart's pulsation or the shadowy *simulacum* of our father's ghost. Be prepared for anything, my friends, the strangest is yet to come, and with it marvels that will display the most *outré* effects in science.

Shakespeare may have been wrong when he tells us "'Tis better to endure the ills we have, than fly to others that we know not of." We will soon know them all. With the hope that our friends of the convention will be on hand a year hence, at whatever spot may be chosen, we bid them for the present a kindly adieu.

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The system of continuous rails by welding them together at the joints instead of joining them by fish-plates and bolts is coming largely into practice in America. The difficulty hitherto has been the behavior of such joints under variations of temperature; and if they succeed in a country where the extremes of temperature are greater than in Britain, there is no reason why the system might not be adopted here. We are told by the *Iron and Coal Trades' Review* that while the use of electrically-welded rails in Boston has not been an entire success, some six per cent. of the joints breaking during the first winter they were in use, it appears from a paper read before the Engineers' Club, of St. Louis, that in that city a great measure of success has been attained. Mr. Robert McCulloch, the author of the paper, states that of 2,203 electrically-welded joints on 3¼ miles of double track in St. Louis, seventy-two joints, or 3.27 per cent. have broken. Thirty-seven broke during the cold weather of the first part of last winter, and each was repaired by casting a mass of iron around the broken part, a portable furnace being employed to melt the iron. During the second cold snap, later in the same winter, thirty-five further breaks occurred, which have not yet been repaired. Seven of the joints opened nearly two inches on breaking, while in others the crack was barely perceptible; the average amount of opening was one-quarter inch. During the warm weather of the past summer these cracks closed a trifle, but the amount of the movement was unimportant. The maximum deviation from the average temperature at which the welding was performed has been about 75 degrees. Every joint that has broken has shown traces of imperfect welding; in all cases the rail ends have simply pulled apart, the lugs remaining fast to the rails, which held them the tighter. This experience is contrary to that in Boston, where the rails themselves broke near the weld. The machines used in making the welds in St. Louis were sent from there to Cleveland, where 3,400 joints were made in the summer of 1894. Six of these joints, or 0.18 per cent., broke during the last winter, each failure being due to imperfect welding. The method of making continuous rails by casting a mass of iron around the joints has been tried in St. Louis, Chicago, St. Paul, Minneapolis and Newark. About 27,000 of these joints have been cast in the cities mentioned, and the results are reported to be satisfactory to both the railway companies and the contractors.—*Trade Journal Review.*

THE DYNAMO.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

By looking back upon the past few years, the dynamo appears as a new and untrustworthy device. It was a very interesting piece of mechanism and produced a current capable of doing many wonderful things, but it was not received with confidence. Today what a change has occurred. It is a part of every large hotel equipment, a necessity to public and municipal buildings. The elevators of many tall structures depend upon it and the newest developments tend to force its application for heating our dwellings as well as supplying both light and power.

Principles.—It is encouraging to know that the principles upon which a knowledge of the dynamo is based are of a simple, uncomplex nature, and it may free the mind from doubt and hesitation to realize that even the early history of the dynamo possesses an interest which unconsciously ripens it by its preparation for the subsequent facts which follow. Not even do our efforts flag in investigating the brilliant successes of Faraday.

The work was not achieved by an individual, but by many. The seed which led to one of the greatest industries in the world was planted by a careful gardener, whose discriminating mind selected the richest soil in which to place the precious germ.

But its first growth was not very productive. It required many others of recognized genius, whose ability drew comments from their own government to healthfully develop the first idea. Edison in America, John Hopkinson in England, Siemens in Germany and Pacinotti in Italy added their portion to the accumulating heap of facts. From the very first and most elementary discovery of Faraday sprang a host of useful principles to which we owe the growth and practical utility of the modern dynamo. The elements by reference to which the action of the dynamo can be understood will be contained in the following notes.

Arago in 1824 noticed that a magnetic needle would not swing as often when near a metallic body as it would when isolated from it. Copper exercised the most striking

effect, and was spoken of as being able to reduce the oscillations in a short while from 300 to 4.

In 1825 he discovered that a plate of copper, rotated under a suspended magnet, caused the magnet to deflect in the direction of motion. Two other experimenters, Bubbage and Herschel, repeated Arago's experiment and drew up a table showing the relative effects of this action on different metals:

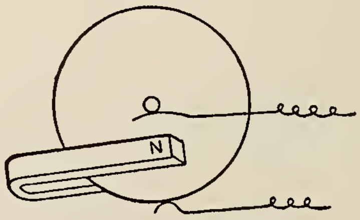
Copper,	100.
Zinc,	95.
Tin,	46.
Lead,	25.
Antimony,	9.
Bismuth,	2.

Faraday with characterestic genius explained these effects in a manner acceptable even to the most sceptical minds. The rotation of the magnet above the copper disk generates currents in it which react upon the magnet. The way in which they react is to destroy the swing of the needle, in the first case, or force the magnet or needle out of its customary position in the second. The law, framed by Lenz, which covers all such cases in which a magnetized body and a metallic mass move in each other's neighborhood is as follows:

Lenz's Law.—In all cases of electromagnetic induction, the induced currents have such a direction that their reaction tends to stop the motion which produced them.

It is but necessary to appreciate this fundamental fact, and the phenomenon of electromagnetic induction in all its phases appears as but a simple and reactionary effect. In fact, to some minds the presence of a current by the movement of the magnet was expected. A force cannot be applied at one point without producing some equally disturbing effect at another. Matter is simply the material by which a given amount of power is transmitted and, therefore, a swinging magnet radiating lines of magnetic force must create in the conductor they strike some such remarkable effect as we perceive. The idea of Faraday's regarding the disk of Arago took root. Faraday himself, in 1831, discovered the principle of induction; he followed the path of Arago and constructed a small dynamo. It consisted merely of a disk of copper revolving between the poles of a magnet, but it gave a continuous current and was named the Faraday disk dynamo.

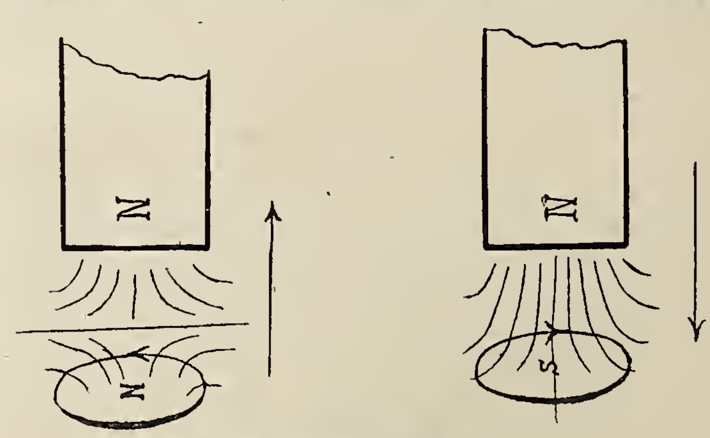
Today machines are used of the same construction in



FARADAY'S DYNAMO.

some electro-metallurgical works. Noting in mind the fact that a magnet moved in front of a conductor has its motion resisted, or the converse, a conductor moved past a magnet has its motion resisted, the reason why such retardance is necessarily due to induced currents becomes pretty evident. A magnet moving through the air cannot be held any more than any other object, unless by the presence of another magnet. Neither have touched, yet they either repel or attract each other.

If currents are induced in a mass of metal or a conductor by a magnet, and the production of such currents means



ELECTRO-MAGNETIC INDUCTION.

resistance to further motion, it is highly evident that the disturbing influence is magnetic, otherwise the magnet would be unaffected. Also the currents which are reduced, and which affect the moving magnet, must hold it back when it moves away and push it away when it moves back. Any movement whatever restrained, and this restraint is investigated from these two standpoints.

(1) Motion of magnet to a coil
(2) " " " from "

THOMASTON, ME.—Work will be commenced at once on the construction of the electric railroad at Thomaston.

RECENT DEVELOPMENTS IN VACUUM TUBE LIGHTING.

A paper presented at the 105th Meeting of the American Institute of Electrical Engineers, New York, April 22nd, 1896.

BY D. MCFARLAN MOORE.

(*Continued from Page 216.*)

WITHIN this low vacuum is placed a wire which can be bent and shaped into any form desired, as shown in Fig. 5. When connected to the vibrator, the beautiful effect is immediately apparent, the wire being enveloped in a delicate purple glow. This can be applied to various purposes, such as advertising. One wire only connects this sign tube to the vibrator, and it is attached to the armature terminal of the vibrator, because when so connected it is the one which receives the high potential discharge of the magnet. In the bulb now shown (Fig. 6) the vacuum is higher, and

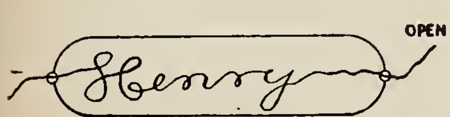


FIG. 5.

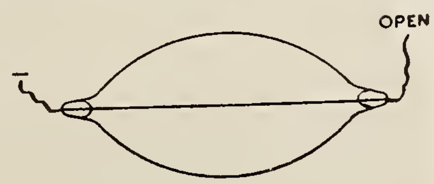


FIG. 6.

a single wire extends through the centre. The light, instead of appearing as a purple envelope around the wire, now fills the entire chamber with a beautiful milky glow.

Close inspection, however, reveals the fact that there is a very small dark space immediately encircling the wire, and beyond it there appear to be rapidly moving rings of light, concentric with it. In fact, one is reminded of the field of force surrounding a conductor, as displayed by the familiar arrangement of iron filings—indeed, it is a similar phenomenon—the molecules of the residual gas taking the place of the iron filings.

The next bulb (Fig. 7) is similar to the one last shown, but with one exception. The wire is not single throughout

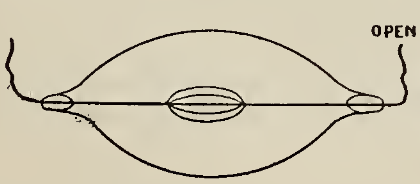


FIG. 7.

FIG. 8.

out its entire length; for a space of about three inches at its centre it separates into six strands, which thereby form a kind of cylindrical cage about one-half inch in diameter. In this case the entire bulb is not filled with a glow, but the interior of the cylinder forms a pencil of light quite dense, denoting that a new principle is brought into play. It is this—every current creates its own electrostatic field around its conductor, which, when immersed in a gas at the proper degree of rarefaction, causes it to give forth light, which is most dense in a comparatively small circle surrounding the conductor. (See Fig. 8.)

When two wires, each having its field of force, are placed parallel to each other and about one-half inoh apart, the density of the field between them will be doubled and consequently the light in almost the same proportion. It will thus be clear that the pencil of light is due to the intersecting or overlapping of the fields of force of each of the six strands forming the cage. Upon this new principle many interesting lamps have been constructed, the problem being to get a maximum number of fields of force to intersect. Probably the best solution is in a cylinder made by spirally winding a wire, as in Fig. 9, causing its field to intersect in a manner that is almost ideal. This explanation many seem at variance with Faraday's famous experiment, proving that an electrostatic charge does not reside in the interior of the charged body. The vacuum may make the difference.

In this bulb (Fig. 10) there are two separate terminals

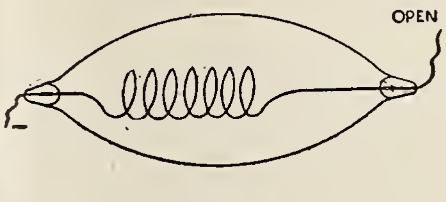


FIG. 9.

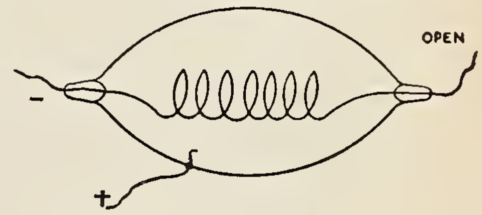


FIG. 10.

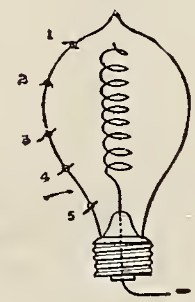


FIG. 11.

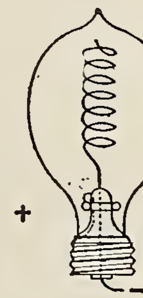


FIG. 12.

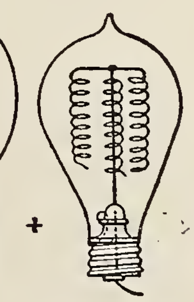


FIG. 13.

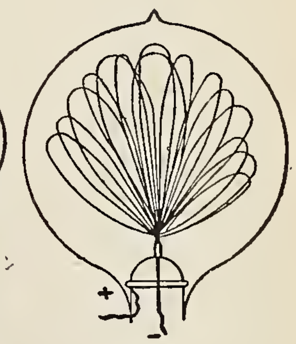


FIG. 14.

projecting from the glass. When the spiral is connected to the negative pole of the vibrator, and the other terminal is made positive, the light is greatly increased. Such a lamp can be very conveniently made by using an incandescent lamp bulb, as in Fig. 11. The bit of platinum wire extending into the bulb and forming the positive pole, can be placed in any of the positions, 1, 2, 3, 4, 5, without affecting the light in the spiral, but it is apt to become heated, and this is remedied by attaching to it a metal wire ring. (See Fig. 12.)

In these lamps a large proportion of the light is confined within the spiral, and since volume is desirable, the idea of increasing the number of spirals suggests itself, as in Fig. 13. But the total volume of light emitted by four spirals is only equal to that of a single spiral lamp, that is, each pencil is but one-fourth as bright; hence, to bring them all to full brightness, the energy of the inductive current should be increased in proportion.

With the idea of obtaining from the entire bulb a uniform glow, the lamp shown in Fig. 14 was constructed. The "filament" consists of a great many complete loops of very fine aluminium wire. Fine wire was used, not only because of appearance and weight, but also for two other reasons: 1st, because a fine wire has about as large a field of force as a much larger wire; and, 2d, because it does not obstruct the light so much, and at the same time is a minimum of metal within the vacuum. This is a matter of much importance, as upon it largely depends the life of the lamp. A great many different conductors were used for the construction of these filaments, the main idea being to use that material which contained the least occluded gas, and would be disintegrated a minimum by the action of the current. Fig. 15 shows ordinary incandescent lamp filaments utilized in a glow lamp, but one leg only is cemented at the centre of the bulb to the negative terminal, the other being free—a veritable fountain of filaments. A rather curious and not entirely explained phenomenon was noticed in this form of lamp, *viz.*, the free ends of the filaments were apt to be violently agitated, and whenever they touched the glass of the bulb they heated up to a bright red throughout their entire length, producing a most brilliant combination glow and incandescent light. Many are the advantages of these lamps over those using fluorescent materials, as the sulphide of zinc or calcium. Sometimes, when the exhaustion is carried a little too far, the vibrator current is unable to affect the lamps, but after they are held in contact with one pole of a large induction coil for a few moments and then connected to the vibrator current the trouble ceases.

In all of these forms of lamps it is very interesting to note that in order to get maximum light the subdivided terminal of the lamp must be so connected to the mains that it is negative. This is interesting to remember when the subject of lighting tubes is considered.

The class of lamps will now be considered where, instead of subdividing the lighting electrode into filaments, plane surfaces are used.

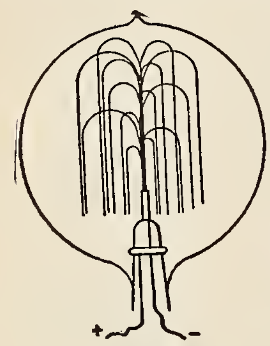


Fig. 15.

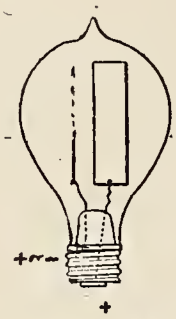


Fig. 16.

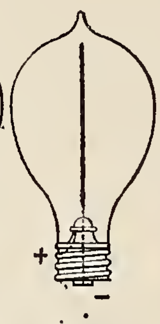


Fig. 17.


Fig. 18.

The bulb in Fig. 16 contains two pieces of sheet aluminium equal in size, set with their planes at right angles to each other, in order that a minimum of light may be interrupted from any point of view, and that the positive will act as a reflector to the negative. These pieces of aluminium must be carefully cleaned before being placed in the lamp, because any grease upon them will cause beautiful tufts of light all over their surfaces, instead of a glow filling the bulb, and the vacuum will soon be lost. Of course, in a lamp of this construction the poles can be changed with impunity, and if an alternating current be passed through the vibrator both plates will give light, but the total amount will be the same as when direct current is used.

One of the many modifications of this form of lamp was to make the magnetic pole in the form of a small cylinder of aluminium gauze.

Many lamps were made on the principle of a spiral within a spiral; wound in the same or opposite directions, and also of using metallic coatings on the tubes interior and exterior, as well as using bulbs of all shapes and sizes. One important advantage to be noticed in all these forms of lamps is the total absence of the very objectionable striations, such as occur in the ordinary Geissler tube.

Fig. 17 is a very simple form of lamp—merely a single piece of straight carbon filament producing the light.

(*To be Continued.*)

State of New York, Executive Chamber,
Albany, April 30, 1896.

Frank W. Hawley, Esq ,
Chairman Committee of Invitations, Etc.,
New York City.

Dear Sir:—It gives me pleasure to accept your kind invitation to be present at the opening of the National Electric Light Association's Exposition, on the evening of May 4th next, and to release the electric current generated by power taken from Niagara's grand cataract.

As you are doubtless aware I am just now under a great pressure of official duties, but the cause of electrical science involves such manifold and important interests in the scheme of our civilization and material progress that I feel honored and pleased by your request that I shall perform this conspicuous and interesting service. Mankind has witnessed such marvelous discoveries and improvements in electricity, even within the past five years, that our minds are led to wonder whether the world is undergoing a process of revitalization through this subtle energy drawn from the breast of nature.

Please convey to the association my thanks for their courtesy extended to me and believe me,

Very truly yours,
(Signed) Levi P. Morton.

A NOTABLE COLLECTION OF PORTRAITS.

A COLLECTION of over 200 autograph portraits, comprising all the great celebrities of the electrical art and a number of men now rising to prominence or active in the field, has been formed by Mr. W. J. Hammer. These, in nine handsome framed groups, have been loaned by him to the Exposition, where they will be appropriately displayed. The collection not only includes Americans, but is rich in rare photographs of the leading electrical spirits of Europe.

The National Underground Cable Company, manufacturerers of lead-covered underground cables for all classes of service; and the National Conduit Manufacturing Company, manufacturers of the well-known cement-lined tubes for underground conduits and builders of complete subway systems—which two companies are now consolidated and under one management—find themselves so busy at their factories on large orders for street railway cables, telephone, telegraph and electric light cables, and underground conduits, that it will be impossible for them to get their exhibit ready in time for the Electrical Exposition, and they have, with great reluctance, decided to give up the large space which they had engaged in the Exposition hall.

Although it could hardly be expected that these two companies would spend the necessary time to make up their large exhibit while their factories at Harrison, New Jersey, and Hastings-on-Hudson, New York, are compelled to run night and day with double forces of men to keep up with orders, still it is to be regretted that the delegates to the Convention and the visitors to the exposition will be denied the pleasure of seeing a complete underground system, including underground cables, conduits, man-holes, lamp-posts, with all the latest apparatus and appliances, and a street railway system in miniature in operation.

Although the National companies will not exhibit, as explained above, they will be well represented at the Convention and Exposition by Mr. E. S. Perot, Mr. James P. McQuaide, Mr. C. Gallagher, Mr. E. J. Fenlon, Mr. Geo. J. Jackson, Mr. T. F. O'Connor, Mr. E. S. Reid, Mr. D. P. Regan, Mr. H. F. Tate, Mr. F. S. V. Sias and Mr. W. H. Lewis, who will be on hand to extend a hearty welcome to their many friends from all over the country; and the main offices of the company, at the Times Building, New York City, will, during the convention, have its doors of hospitality wide open.

Ft. Monroe, Va., May 5th, 1896.

Messrs. Chas. Selden, of the B. & O.; C. A. Darlton, of the Southern; M. B. Leonard, of the C. & O., and W. C. Wolstrom, of the Norfolk and Western, spent Monday at the Hygeia Hotel, arranging for the annual meeting of Superintendents of Railroads, which will be held on June 17th, next.

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87 Liberty St., New York, March 31, 1896.

To my former patrons, engineers and the trade generally:

I have this day sold to the Ashcroft Manufacturing Company all the patents, good-will and business of manufacturing and selling the Edson pressure-recording and alarm gauges, and supplies connected therewith, which they will continue in as my sole successors, maintaining the high standard the Edson recorders have so long enjoyed. I recommend them to your consideration as capable and progressive manufacturers of first-class steam specialties, and ask a continuance of your patronage for them.

Hereafter please send all orders direct to them, No. 111 Liberty Street, New York City.

Yours very truly,
Jarvis B. Edson.

On Friday, May 8th, Prof. F. B. Crocker, Ph. D., delivered a lecture before the Henry Electrical Club, at 111 West 38th Street, New York, on "Troubles in Dynamos and Motors."

N. E. L. A. AND EXPOSITION NOTES.

THE EXPOSITION BUILDING.

THE exposition is fully open to visitors. No better chance to see what progress has been made in the purely scientific and practical departments will be offered for many years to come. With its fascination and charm the strolling visitor will be duly impressed. The weird influence of a mighty force pervades the very atmosphere. Its silent passage and powerful effects are instantly comprehended. The most flippant will not fail to be affected with a sense of admiration, of most astonished wonder at the power and scope and unlimited possibilities of this newly applied force.

The appliances by which it is guided and controlled are also subjects of deep interest to the visitor; some of these noticeable exhibits are given below.

THE most beautiful exhibit at the exposition. This is the general expression of all at the electrical show of of the Safety Insulated Wire and Cable Co., of 225-239 West 28th street, New York. They occupy 200 square feet of space on the main floor and simply magnetize the sauntering spectator with their brilliant display. At the left-hand end of Safety exhibit are frames telling of the advantages and uses of Safety wires and cables. In one frame is a fac-simile of a Western Union telegraph blank, inviting delegates to call and see their extensive plant at 225 West 28th street, New York. At right-hand side of exhibit is a frame explaining the various styles of wire and cables made by the Safety Company. In a part of the exhibit is a photo. of the steamer St. Paul stranded at Long Branch, showing a Safety cable connecting it by telephone with New York City. All the various signs are electrically connected, showing every color, with electric lights, which change automatically, giving a brilliant effect. In the telegram of the Western Union Telegraph Company each word was brought out separately and the invitation is spelled out with striking effect. Mr. Richards, the representative of the company, and Mr. Clark, the electrical engineer, deserve great credit for the execution of the work in this exhibit. In the front of the exhibit are handsome oak tables containing samples of all sizes of Safety insulation, wires and cables. The whole force of representatives took great pride in attending to this beautiful exhibit. Among the assistants to Mr. Leonard R. Requa, the general manager of the company, were Mr. Eckert, Mr. Henry, Mr. Williams, L. F. Requa, Jr., and Mr. Holloway; also their Boston agent, Lieut. F. B. Parsons, entertaining delegates, and Mr. Douglas, the Southern agent. Lieut. Spencer, Western agent, is also on hand at the stand.

The American Circular Loom Company received in the Murray Hill Hotel. The receptions they held were continuous. Messrs. Brooks and Clark, of Boston, and Messrs. Doubleday and Kirkland, of New York, were kept busy entertaining the numerous and influential guests.

The company occupied parlors No. 120, 122, 124 and 126.

This company's goods have obtained such a strong hold on contractors and underwriters that their use will be continued and their sales large for many years to come.

F. Heilrath operated the electric embroidering machine run by Crocker-Wheeler Electric Company's motor. Mr. Hunt, of the ELECTRICAL AGE, has his full name worked out on a handkerchief by this machine. Mr. Heilrath, the operator, is an expert at machine embroidering and produces the most pretty effects. The firm of Schirmer, Blau & Company sell these machines in Berlin, S. O. 145 Köpnicker strasse.

Mr. William C. Ballda, of the Utica Electrical Mfg. and Supply Company, Utica, N. Y., was in attendance at the exposition, and was so pleased that he has decided to see the week out among the exhibits. You may correspond with him at the Metropole Hotel, New York.

Keuffel & Esser Company, 127 Fulton street, New York, the noted manufacturers of drawing materials, etc., have a superior exhibit containing a full line of supplies for electrical engineers, indoor, office and field work, drawing boards, Helios blue print paper, calculating instruments and special instruments for surveying electric railways. Mr. J. A. Schildecker is looking after the exhibit. It is a very excellent showing for the company in its complete and useful display.

Messrs. Gordon & Burnham, with their able assistant, are deserving of much praise for their attractive exhibit. They have a pyramid of their noted closed circuit batteries; in the three corners are handsome Geissler tubes kept constantly illuminated with X-ray fluorescence; they have several cells of their battery connected to a 4-inch Ruhmkorff coil, International make. The office of the Gordon & Burnham Battery Co. is 82 West Broadway, N. Y. These batteries are the best for X-Ray outfits, as they give a constant current on closed circuits—they will give 8/100 of an ampere for six months constantly. We would advise our readers to write for detailed circular of these batteries. Send your order for sample set of batteries, and try them, and you will use them constantly.

A. O. Schoonmaker, the mica segment manufacturer, of 158 William street, N. Y., has a very neat exhibit showing samples of fine mica cut to fit railway motor commutator segments, and clear mica in sheets ready to be cut to suit your requirements.

The Okonite exhibit is right up to date, decorated by a skilful artist, and containing an immense ball of pure Para rubber ready to be used in insulating their famous wires and cables. Geo. T. Manson, the superintendent of the works, is giving attention to the exhibit. Manson tape is one of the standard products of the Okonite Co. The lady visitors kept Mr. Manson busy explaining the virtues of okonite insulation.

H. C. ADAMS, JR.

HARRY C. ADAMS, JR., is so popular a young man it is hardly necessary to tell you his history. All the buyers of Insulated Wires know him for his *suave* manner; all the trade knows him for his integrity. You will recognize him at the Exposition by the above likeness and his charming smile. He is New York agent for Phillips Insulated Wire Co., 39 Cortlandt street.

John A. Burns, B. A. Sc., of Munderloh & Co., of Montreal, electrical supplies of all kinds, is at the Exposition. They make a specialty of P. & B. compounds and specialties.

COL. W. S. ROGERS.

COLONEL ROGERS is officially attending the Brush Electric Co.'s exhibit, consisting of 125 arc lamps, one dynamo of 125 lights and one of 100 lights. Each dynamo is built to run either one, two, or three circuits, and any amount of lamps on either, without interference from the others. This is the solution of one of the greatest problems in arc lighting, and since its introduction is a great boon to central station men. They can now enlarge their units and save floor space by having only one machine to care for. The old circuits can be maintained by this device if necessary.

Mr. S. M. Hamill, vice-president of the Brush Co., has had an extensive experience which led him in this case to suggest the advantages of this innovation in arc-light practice.

The headquarters of the Brush Electric Co. is under Colonel Rogers' personal supervision at the Imperial Hotel, 33d Street and Broadway. He was kept busy receiving his friends, which include quite a large circle, and at the Exposition he was the centre of gravity of many more. In his work he is assisted by competent aids, J. R. Prentiss and H. T. Douds.

The Brush Co. have recently made an addition to their plant in the shape of one 100-light arc machine, direct-connected to an Edison motor. They propose to run 125 lamps in their exhibit by this dynamo. All the lamps can be instantly cut off without injury to the machine.

The Colonel has had quite an eventful career. Born in 1848, serving in the Union army at 15, a member of the firm of Wiggins & Rogers, government contractors, reading clerk of the Illinois legislature, one of the men electing John A. Logan to Senate, and colonel on General Ogleby's staff, show the active spirit within him. He established the Electrical Accumulator Co.; had much to do with the origin and growth of the Municipal Electric Lighting Co., one of the greatest arc light plants in the world, and superintended the construction of the Grand View Beach Railroad, at Charlotte, N. Y., requiring 4,100 feet of trestle work. In 1891 he made some of the largest sales in the Brush Co, and has always proved himself a man of conscientious and trustworthy ability.

* * *

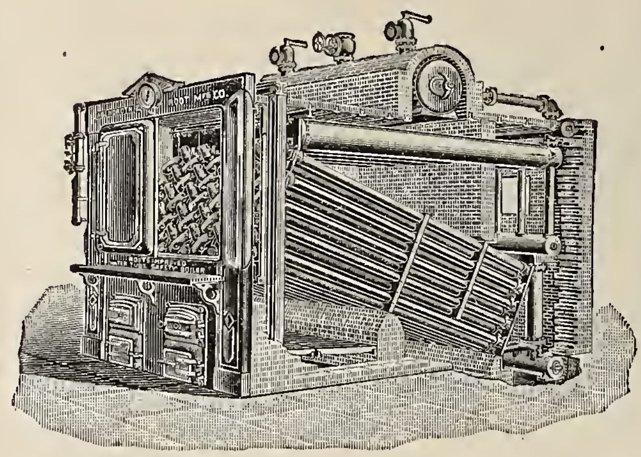
J. J. Shultz, the well-known sable rawhide-belt manufacturer, of St. Louis, Mo., is here with his able assistant and New York manager, Mr. A. B. Laurence of 117 Liberty street, N. Y., and Mr. A. C. Laurence. Messrs. Laurence, as usual, have secured the best spot for exhibiting their well-known belts. Mr. A. B. Lawrence was successful in

J. J. SHULTZ.

A. B. LAURENCE.

placing their sable rawhide belts on the N. Y. Safety and Weston engine exhibits, one plain and one grooved belt are on these engines. The attraction of the Shultz exhibit is the noted trade-mark of the firm running by electric motor. They have in miniature the Earth driving the Sun with one of their sable belts, the sun spinning like a top.

THE EXHIBIT OF THE ABENDROTH & ROOT MANUFACTURING CO.



ONE of the most interesting exhibits to both the layman and the engineer is the boller plant of the Abendroth & Root Manufacturing Co. This is an exact duplicate of the twelve batteries of boilers used at the celebrated tunnel plant of the Baltimore and Ohio Railroad, in Baltimore, Md. This battery furnishes all the steam used at the exposition, there being two equal units forming one battery of five hundred horse-power. An examination of the boilers will show that they are composed of a regular arrangement of wrought iron, lap-welded boiler tubes, grouped in such a manner that they are arranged vertically in a staggered position. By arranging the tubes so as to make the boiler of any practical width, or piling them to any practical height, it is not only possible to *increase* the heating surface of the boiler, but, also to *vary* its amount. Every possible provision has been made to insure the most rapid and effective circulation and also the delivery of dry steam. Visitors will have noticed the young lady superintending the plant.

By observing the different gauges and merely pressing an electric button, she is enabled to supply fuel and feed water, regulate the dampers dispose of the ash, etc., without difficulty; the entire working of the boilers being automatic.

G. HUERSTEL.

MR. G. HUERSTEL, manager of the International Electric Co., of 76 Beekman street, New York, can be found at the exposition nightly, looking after the many exhibits of Ruhmkorff coils used for X ray and other applications.

This firm make a specialty of finely wound coils for all electrical purposes; binding posts, telephone and gas lighting coils and wire winding generally. Small machinery made from designs.

PAPERS DISCUSSED AT CONVENTION.

"Evolution of the Inductor Alternator." Paper by John F. Kelly.

"Single-Phase, Self-Starting, Synchronous Motors." Paper by F. H. Leonard.

"Results Accomplished in Distribution of Light and Power by Alternating Currents." Paper by W. S. R. Emmet.

"The Light of the Future." Lecture by D. MacFarlan Moore.

"Evolution of the Arc Lamp." Paper by L. H. Rogers.

"Steam Boilers; Their Equipment and Management." Paper by Albert A. Carey.

"Electrolysis." Paper by Captain William Brophy.

"Equalizer Systems of Distribution." Paper by A. Churchward.

"Acetylene Gas." Paper by L. A. Ferguson.

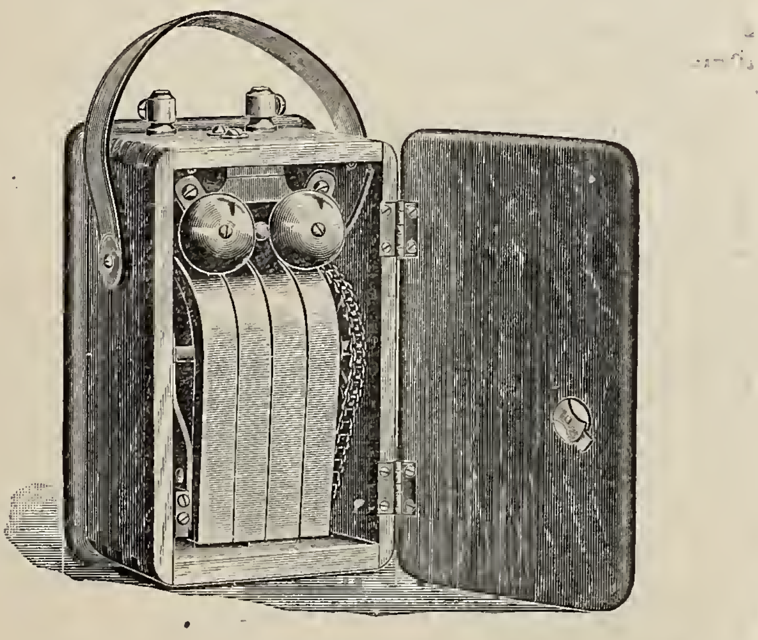
"Evolution of Interior Conduits: From an Electrical Standpoint." Paper by Luther Stieringer.

"The Desirability of a Standard Socket." Topic: Discussion opened by Alfred Swan.

"The Roentgen Ray." Lecture by Max Osterberg.

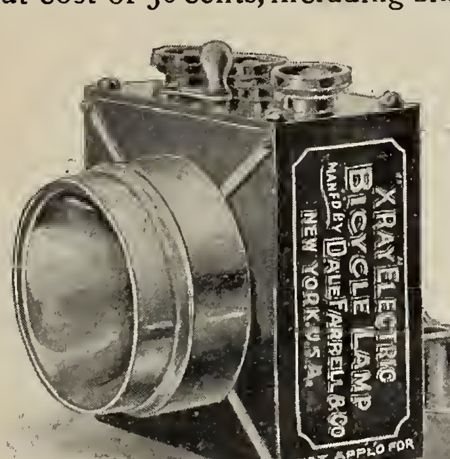
DALE, FARRELL & CO., electrical and mechanical engineers, main office and factory, 413 and 415 East 25th street, occupy this entire building, also a rear building not shown in cut. For the convenience of their customers they have a downtown office in American Tract Society Building, 150 Nassau street. Their exhibit at the Electrical Exposition is No. 130, section F, which is to the right of the main entrance. They are represented by John C. Francis, Geo. A. Lutz and Walter S. Doe. The factory is fully equipped with all modern machinery for heavy or light work.

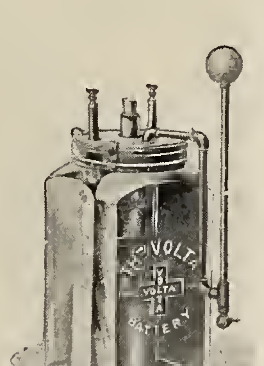
They exhibit their Volta primary battery, E. M. F. two volts, with an efficient discharge of 25 amperes from one cell. Positively will not polarize; hermetically sealed, so



TESTING SET.

there are no fumes given off. To charge, fill outside jar with water to top of zinc and inside with "electroline," or dilute nitric acid answers very well; then replace stopper. The gas given off from the carbon element creates a pressure in gasometer or center cell causing the acid to percolate through the porous cup and attack the zinc; the harder the battery is worked the more acid is forced through the porous cup to attack the zinc. Will give 600 ampere hours at cost of 38 cents, including zinc consumed, which is about

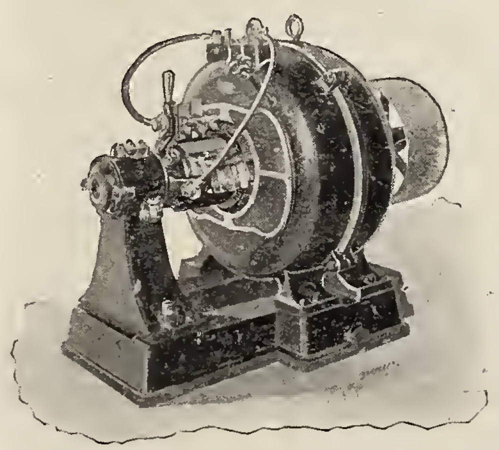




one-seventh the cost of any other known battery. Zinc is heavy enough to last 4 to 12 months, according to usage.

After about three fillings of the porous cup the outside jar will be full, so the liquid is drawn off the proper height again with special siphon, as shown in cut. X-ray electric bicycle lamp gives a steady white light for six hours. Jarring of wheel does not affect it; only improves the light, if anything. No zincs to clean or renew and no connections to make, as the zinc element is included in the cartridge with which the battery is charged. Charges are made from one to six hour sizes, and the largest size, which is less than a cigarette, can be dropped in without getting off wheel.

They have a fine exhibit at the exposition of their magneto call-bells, primary batteries, trolley line supplies and X-ray bicycle lamps. They handle many specialties in a very successful manner. Among the same are the Edwards car-fender, Sheridan lighting jack and an Arber press. With such industry as they have shown, their exhibit is a fair proof of a prosperity that is a pleasure to behold.



THE INTERIOR CONDUIT AND INSULATION COMPANY have an exhibit second to none, in charge of Messrs. Durland, Kimber and Kittle, their representatives. A pony two-revolution printing press, driven direct by a Lundell motor, attracted considerable attention and was pronounced by experts to be a perfect model. Their organ-blowing outfit furnished wind for a two manual organ and the public were treated to some very fine music. Lundell motors and generators of all sizes down to one-twelfth horse-power were on exhibition and a large number running. The dental apparatus operated by electric motors were shown and also a full line of ceiling fans and bracket fans for alternating and direct currents.

A complete line of the company's new underground conduits for the reception of trolley feeders, electric light wire and telephone and telegraph cables, and also a complete line of plain brass armored and iron armored conduits and fillings for interior wiring. Exhaust fans of the Davidson, Starbuck, Sturtevant, Huyett and Smith type were operated by Lundell motors direct-connected. An attractive feature of the whole exhibit was a large illuminated electric sign. Taking the whole exhibit together it was one of the most attractive features at the exposition and reflects great credit upon the company and their employés, who devoted such faithful attention to the details.

THE BOARD OF DIRECTORS of the Sawyer-Man Electric Company have much pleasure in announcing that the company has been reorganized, and that the manufacture of the Sawyer-Man incandescent lamp has been resumed. This, no doubt, will be welcome news to every user of incandescent lamps in this country, for the reason that for economy, long life and efficiency, the Sawyer-Man incandescent lamp never had a superior on the market.

DIEHL MANUFACTURING CO., of Elizabethport, N. J., salesrooms, 561 and 563 Broadway, New York, are very handsomely represented at the exposition with a beautiful bower of a booth, containing all their electrical specialties in ceiling fans, direct-connected sewing machine motors, power motors, incandescent arc lamps, all of modern designs. A very highly efficient choir of attendants is nightly on hand explaining the virtues of the goods.

GEO. W. BROWN, president of the Belknap Motor Co., Portland, Maine, arrived at the exposition Thursday night, and was delighted. The Belknap Co. are installing two complete marine plants of 300 lights capacity each, with search lights on the steamers Cottage City and Manhattan of the Maine Steamship Co.

THE ATTENDANCE.

Boston.—H. L. Albright, W. S. Hill, G. M. Angier, C. W. Holtzer, James I. Ayer, A. W. Ives, M. H. Barker, A. B. Jenks, W. S. Barker, F. M. Kimball, C. E. Bibber, Thos. D. Lockwood, Capt. William Brophy, E. C. Lewis, J. F. Bubert, Norman Marshall, Arthur E. Childs, J. H. Mason, J. Couilliard, H. C. Patterson, S. B. Condit, Chas. B. Price, Henry B. Cram, C. J. Reilly, B. W. Cutter, P. M. Reynolds, H. M. Daggett, Jr., Frank Ridlon, Geo. W. Davenport, R. F. Ross, C. B. Davis, T. C. Sias, D. W. Dunn, F. B. Smith, C. L. Edgar, H. C. Spaulding, W. J. Ferris, Calvert Townley, T. W. Flood, Donald F. Urquhart, H. F. Golsin, G. W. Ward, F. A. Gilbert, C. A. White, C. E. Gregory, F. B. Witherbee, C. S. Haley, James Wolff, J. Y. Hamby, C. J. H. Woodbury, H. C. Hawks, A. Arthur Ziegler, J. M. Orford, James Bradley, Sidney Hosmer.

Bangor, Me.—J. N. V. Lane, W. E. Pierce.

Bristol, Pa.—Chas. E. Scott, Benj. J. Taylor.

Camden, N. J.— Judge E. A. Armstrong, J. J. Burleigh, C. C. Burleigh.

Chelsea, Mass.—E. A. Chapel, Geo. W. Moses, W. G. Peck.

Chicago.—Foree Bain, R. J. Randolph, Henry Cribben, J. R. Wiley, W. J. Ferris, James Wolff, W. Forman Collins, C. J. Reilly, C. H. Wilmerding, A. F. Golsin, C. E. Gregory, H. L. Albright.

Cincinnati, O.—John I. Beggs, J. A. Cabot, Thomas J. Creaghead, J. S. Nowotny, W. M. Venable.

Cleveland, O.—Victor Browning, M. M. Hayden, L. H. Rogers, W. B. Cleveland, S. C. D. Johns, S. K. Johns, George M. Hoag, Benj. T. Miles, Bailey Whipple.

Columbus, O.—A. W. Field, Adolf Theobald.

Detroit.—C. H. Matthews, C. A. Ducharme, Alex. Dow.

Fitchburg, Mass.—H. F. Coggeshall, A. H. Kimball.

Fostoria, O.—J. B. Crouse, H. A. Tremaine.

Hartford, Conn.—Gerald W. Hart, A. H. Pease, E. B. Hatch, Chas. E. Dustin, C. E. Newton.

Houghton, Mich.—James A. Dee, Lessing Karger, Irving J. Sturgis.

Locrport, N. Y.—F. E. Ellsworth, I. H. Babcock.

Lowell, Mass.—L. A. Derby, J. Arthur Gage.

Manchester, N. H.—E. M. Bryant, Albert Merrill.

Milwaukee, Wis.—W. F. Hyde, A. Smith, Julius Goldschmidt, Thos. R. Mercein.

Montreal, Can.—Prof. H. T. Bovey, Wm. H. Browne, Robert A. Ross, F. R. Redpath, Geo. W. Sadler.

Newton, Mass.—Waldo A. Learned, W. E. Holmes.

Newark, N. J.—F. F. Gardiner, C. McIntire.

Norfolk, Va.—James L. Belate, W. W. Chamberlain.

New Bedford, Mass.—C. S. Mendell, Charles R. Price, A. P. Smith, George R. Stetson.

New Britain, Conn.—T. H. Brady, Robt. S. Brown.

Ogdensburg, N. Y.—J. H. Findley, George Hall, W. L. Proctor.

Olean, N. Y.—George Fobbs, Welles E. Holmes.

Pittsfield, Mass.—W. R. Gardener, Henry Hine, J. F. Kelly.

Philadelphia.—James G. Biddle, C. W. Lzar, C. A. Bragg, A. H. Manwaring, H. B. Cutter, S. L. Nicholson, C. M. Corpening, A. B. Poulson, J. T. Cowling, O. D. Pierce, A. J. De Camp, J. P. Richardson, F. W. Darlington, Chas. J. Russell, Geo. W. G. Holman, T. Carpenter Smith, W. E. Harrington, C. M. Wilkins, A. H. James, E. T. Wilkinson, W. O. Knudson, E. Ward Wilkins, E. G. Willyoung.

Pittsburgh, Pa.—B. H. Blood, J. W. Marsh, J. S. Crider, A. H. Mustard, Ernst H. Heinrichs, C. F. Scott, Robt. J. McGonnigle, H. E. Webb.

Providence, R. I.—J. F. Blauvelt, Frank N. Phillips, Eugene F. Phillips, C. R. Remington.

Quincy, Ill.—J. W. Emery, C. H. Casth.

Rochester, N. Y.—J. A. Olmstead, F. Kirk Knowlton, Fred Fish, J. E. Putnam, George A. Redman, Charles F. Barnes.

Rockland, Me.—T. Hawkins, Geo. E. Macomber.

Rutland, Vt.—J. H. Francisco, M. J. Francisco.

Schenectady, N. Y.—J. P. Feeton, E. W. Rice, S. D. Greene, C. P. Steinmetz.

Springfield, Mass.—J. E. Madison, H. S. Anderson.

St. Louis.—E. H. Abadie, John Mustard, H. A. Wagner, Sylvester Watts, Edwin S. Pillsbury, J. A. J. Shultz, E. G. Spencer, J. H. Rhotehamel.

Syracuse, N. Y.—W. H. Garvin, H. J. York, D. McAfee.

Waterbury, Conn.—A. M. Young, A. O. Shepardson.

Windsor, Conn.—A. D. Newton, M. E. Baird.

Worcester, Mass.—Chas. W. Bassett, W. H. Coughlin, John P. Coughlin, H. H. Fairbanks.

Washington.—Fred D. Royce, H. G. Balkam, Fred W. Royce, James Kennedy, A. A. Thomas.

Adams, N. Y.—W. L. Pratt.

Atlanta, Ga.—N. Y. Edgar.

Baltimore, Md.—J. W. Ellard.

Binghamton, N. Y.—S. D. Cushing.

Brattleboro, Vt.—F. Taft.

Bryan, O.—W. A. Sheldon.

Buffalo, N. Y.—Walter Wentworth.

Canandaigua, N. Y.—C. J. Purdy.

Canajoharie, N. Y.—C. S. Fargo.

Carbondale, Pa.—J. W. C. Aitken.

Charlotte, N. C.—H. Thompson.

Colorado Springs, Col.—E. E. Wade.

Concord, N. H.—George B. Lander.

Cuyahoga Falls, O.—C. L. Babcock.

Dayton, O.—H. W. Fullerton.

Derby, Conn.—R. E. Nugent.

Easton, Pa.—E. C. Hillyer.

Elizabeth, N. J.—E. N. Stevens.

Fall River, Mass.—G. W. Palmer.

Frederick, Md.—Dudley Page, Arthur L. Bosley.

Germantown, Pa.—Chas. M. Allen.

Haverhill, Mass.—S. B. Libby.

Hamilton, O.—Felix Kuhn.

Hazleton, Pa.—A. Markle.

Holyoke, Mass.—S. B. Winchester.

Hornellsville, N. Y.—L. T. Mason.

Ithaca, N. Y.—Edward L. Nichols.

Kearney, Neb.—Geo. W. Frank, Jr.

Lansing, Mich.—Philip B. Woodworth.

Little Rock, Ark.—E. V. Fish.

London, Ont.—Charles D. Hunt.

Marion, Ind.—R. E. Lucas.

Massillon, O.—J. W. Fisher.

Mechanicville, N. Y.—H. J. Medbery.

Memphis, Tenn —S. T. Carnes.

Meriden, Conn.—Herman Nimkwitz.

Moreborough, Mass.—H. Bottomly.

New Brunswick, N. J.—A. J. Jones.

Newton Centre, Mass.—Dr. Louis Bell.

Pana, Ill.—H. Hadley.

Pawtucket, R. I.—D. W. Dunn.

Peabody, Mass.—P. L. Winchester.

Peru, Ind.—J. H. Borislog.

Sandusky, O.—J. S. Speer.

Toronto, Ont.—Frederic Nicholls.

Troy, N. Y.—E. G. Barnard.

Utica, N. Y.—W. C. Ballda.

Warren, O.—W. D. Packard.

Mr. E. J. Hall, Jr., vice-president and general manager of the American (Long Distance) Telephone and Telegraph Co. has very kindly loaned to the Exposition the original long distance telephone set with which, some years ago, Professor Alexander Graham Bell opened the line between New York and Chicago. It has since that time been jealously guarded, and has had a silver plate put upon it with the inscription as to date, etc. Mr. Hall accompanies this with a large picture, illustrative of the event, and with other material bearing upon the occasion. Mr. C. R. Truex has been entrusted with the care and arrangement of this interesting exhibit, which goes in the collection of the Historical and Loan Exhibit Committee.

Elkin, N. C.—An electric watchman's clock, new or second-hand, covering five or six stations, with timeclock, is wanted by the Elkin Mfg. Co.

Telephone Notes.

Sea Isle City, N. J.—The coast resort towns of Cape May County are soon to be connected with Philadelphia, New York and nearby towns by telephone. A line will be run from Port Morris, on the Delaware Bay shore, to Cape May. From Cape May the line will run along the coast through Holly Beach, Wildwood, Anglesea, Stone Harbor, Piermont, Avalon, Sea Isle City and Ocean City.

Lockport, N. Y.—Notice is hereby given that application has been made to the Common Council of the City of Lockport, by the Citizens' Mutual Telephone Co., to grant a franchise for the privilege of constructing, maintaining and operating a telephone line and lines and exchanges, and for such purposes to erect and maintain all poles, etc., in said city.

Oak Harbor, O.—Oak Harbor will have a telephone exchange.

Reidsville, N. C.—The County Commissioners have granted R. J. Oliver, of Reidsville, permission to construct a telephone line from Reidsville as far as the Guilford line to Greenboro, and from Reidsville to Leaksville and Spray.

Ryan, Ia.—Ryan is soon to have a telephone line and perhaps two of them. Stock is already subscribed for a line to run from Coggon to Manchester, and the work will be commenced as soon as the frost is out of the ground.

FOR UPTOWN TELEPHONE SUBSCRIBERS.

An uptown branch of the Contract Department of the Metropolitan Telephone and Telegraph Company has been established at 113 West 38th street (one door from Broadway), where all business relating to the supply of telephone service can be transacted as readily as at the main office at 18 Cortlandt street. There are 14,500 telephone stations in New York City. Metallic Circuit Service, Rapid, Efficient, Permanent, can be had from $75 a year.

NEW TELEPHONE COMPANIES.

Princeton, Mo.—Princeton Telephone Co. Capital, $1,000. Incorporators, Ira B. Hyde, H. G. Orton, and H. C. Miller and others.

Pleasanton, Ia.—The following-named parties have organized what will be known as the Pleasanton Telephone Company: John Painter, Erastus Graham, Joseph Leeper, A. Cozad and others. The line will be run from Pleasanton to Davis City, and from Pleasanton to Lineville. It will connect at Lineville with the line running to Princeton and several other points.

Hagerstown, Md.—Hagerstown will soon be connected with Carlisle by long-distance telephone. Work will be commenced during the next two weeks.

Greenville, S. C.—A scheme is on foot to organize a new telephone system for the city. George A. Browning is at the head of the enterprise.

Elkins, W. Va.—The railroad company is about to erect a telephone line from here to Thomas, W. Va. Work is soon to be begun.

Oak Harbor, O.—Oak Harbor is to have a telephone exchange.

Stroudsburg, Pa.—The telephone line now in operation between Stroudsburg and Bushkill will be extended, to connect with the line between Dingman's Ferry and Port Jervis.

Webster, Mass.—A telephone is to be run from the depot village to the pumping-station at the lake.

Possible Contracts.

Corinth, N. Y.—A scheme is on foot to build an electric railroad between Corinth, Saratoga County, and the Champlain Canal. The enterprise is undertaken principally by the gentlemen interested in the Hudson River Pulp and Paper Co., at Palmer Falls, near Corinth. The power to generate the electricity will be furnished by the falls of the Hudson at Palmer.

Scranton, Pa.—P. J. Horan, of Dunmore, and Charles H. Schadt, of Scranton, are now making decided improvements to the Hotel Pines and the Lake House. An electric light plant is to be put in for the use of the hotels, cottages and dwellings.

Des Moines, Ia.—The Electric Company will be required to put their wires underground.

Newark, N. J.—It is practically settled that Newark's market building and plaza will be lighted with electricity furnished by a plant owned by the city.

New York City.—The New York United Clubs' Building Company has issued a circular setting forth plans for the erection of a fourteen-story building, to cost $1,000,000, at 36th street and Broadway, on a site worth $1,200,000. The building is to contain a theatre, to seat 1,200, a restaurant, gymnasium, club rooms for women and offices.

Key West, Fla.—Electric equipments will be purchased by the Tropical Electric Co. E. H. Martin, superintendent.

Port Jervis, N. Y.—Edward F. Lukens, W. H. Metcalf, G. F. Macrae, directors of the newly organized Stroudsburg-Port Jervis Railway Co., are in town to begin surveys for the construction of a trolley road from Port Jervis to Stroudsburg.

Hammonton, N. J.—Plans were submitted to Hammonton Council for the erection of a city water-works and an electric light plant.

New York City.—Plans have been prepared by Architects McKim, Mead & White for the erection of a ten-story building, to be erected on 44th street and Fifth avenue, at a cost of $750,000, for Isaac V. Brokaw. It is to be occupied by Mr. Sherry as a hotel.

Allegheny, Pa.—The United Presbyterians of Allegheny will erect a seminary to cost $125,000. It will be six stories high and fireproof.

New York City.—Mayor Strong has approved the bill appropriating $80,000 for rebuilding the Tombs Prison and building a wing to the penitentiary on Blackwell's Island.

Brooklyn, N. Y.—At the annual meeting of the Manufacturers' Association of Kings and Queens Counties plans for a new building for the organization were submitted and accepted. The Manufacturers' Building, as it will be called, will be located on Montague street, adjoining the premises of the Continental Insurance Co. It will be four stories high and cost $100,000.

New York City.—Charles Delecker, of Park avenue and 177th street, will build a hotel in Tremont this summer.

New York City—David H. Scully, an uptown real estate broker, is the promoter of a transaction, which he has just closed, to build a theatre on the block facing Third avenue, 142d street and Alexander avenue. The builders, Wm. Seitz, C. W. Gaylor, have purchased this plot and will begin at once on a building that will cost over $400,000. Seating capacity, 1,800.

Detroit, Mich.—The lighting commission has asked for an appropriation of $180,322 for the running of the electric light plant and establishing 200 new arc lights in new territory.

ELECTRICAL and STREET RAILWAY PATENTS

Issued April 28, 1896.

558,924. Multiple-Series System of Electrical Distribution. Francis B. Badt, Chicago, Ill., assignor to the Siemens & Halske Electric Company of America, same place. Original application filed Sept. 25, 1895, Serial No. 563,-601. Divided and this application filed Dec. 6, 1895.

558,953. Eccentric Mounting for Electric-Vehicle Axles. Ernst W. G. C. Hoffmann, Charlottenburg, Germany, assignor to the Siemens & Halske Electric Company of America, Chicago, Ill. Filed Dec. 27, 1895.

558,970. Method of Electrolytic Treatment of Soap-Lyes. Orazio Lugo and Huson T. Jackson, New York, N. Y. Filed Oct. 4, 1895.

558,971. Electric Connection. Joseph W. Marsh, Pittsburgh, Pa., assignor to the Standard Underground Cable Company, same place. Filed May 6, 1895.

558,982. Car-Fender. Simon A. Politsky, Boston, Mass. Filed Aug. 2, 1895.

558,983. Current-Straightening Commutator. Carl Pollak, Frankfort-on-the-Main, Germany. Filed Aug. 28, 1895.

558,989. Hanger for Arc-Lamps. Lyman A. Scovil, Chicago, Ill. Filed Mar. 28, 1893.

558,993. Sefety Arc-Lamp Hanger. Edward P. Snowden, St. Joseph, Mo. Filed Feb. 11, 1896.

559,029. Fender for Street-Cars. Carl A. Hallqvist, Brooklyn, N. Y. Filed June 3, 1895.

559,038. Automatic Electric Indicator System. Gwynne E. Painter, Baltimore, Md. Filed Feb. 26, 1895. Renewed Nov. 1, 1895.

559,039. Electrical Signaling Apparatus. Gwynne E. Painter, Baltimore, Md. Filed Feb. 16, 1895. Renewed Dec. 7, 1895.

559,047. Street-Car Fender. Charles E. Wingate, Lawrence, Mass. Filed Feb. 18, 1896.

559,048. Electric Running-Light and Signal-Lantern for Ships. Joseph Barré, New York, N. Y., assignor to Sophia Barré, same place. Filed Nov. 29, 1893.

559,066. Mast Arm for Electric Lamps. Joseph J. Shickluna, Buffalo, N. Y. Filed Apr. 29, 1895.

559,084. Car-Fender. James J. Renehan, New Britain, Conn. Filed June 19, 1895.

559,091. Car-Fender. Robert Wilkinson, Philadelphia, Pa. Filed Jan. 21, 1896.

559,105. Electric-Railway Conduit. John H. Munson, Chicago, Ill., assignor of two-thirds to William Frank Roberts and James Edward Merritt, same place. Filed Mar. 5, 1895.

559 131. Signaling Apparatus for Pressure-Gauges. Thomas M. Gordon, Boston, Mass. Filed July 10, 1895.

559,134. Milliampere-Meter. Charles M. Hollopeter, Fostoria, Ohio. Filed May 31, 1895.

559.143. Electric Light and Signaling Device. David Missell, New York, N. Y. Filed Feb. 25, 1896.

559,149. Electric-Light Shade. Henry Stenz, Faribault, Minn., assignor of one-half to Joseph J. Weyer, same place. Filed June 27, 1895.

559,168. Connector for Electricity-Carrying Cables. David E. Evans, Baltimore, Md. Filed Nov. 4, 1895.

559,175. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa., assignor to the Thomson Houston Electric Company, of Connecticut. Filed July 8, 1893.

TELEPHONE PATENTS ISSUED APRIL 21, 1896.

559,086. Telephone and Calling System. Charles B. Smith, New York, N. Y., assignor of two thirds to Robert G. Vassar and James G. Smith, same place. Filed Nov. 18, 1895.

559,087. Telephone and Calling System. Charles B. Smith, New York, N. Y., assignor of two-thirds to Robeit G. Vassar and James G. Smith, same place. Filed Nov. 19, 1895.

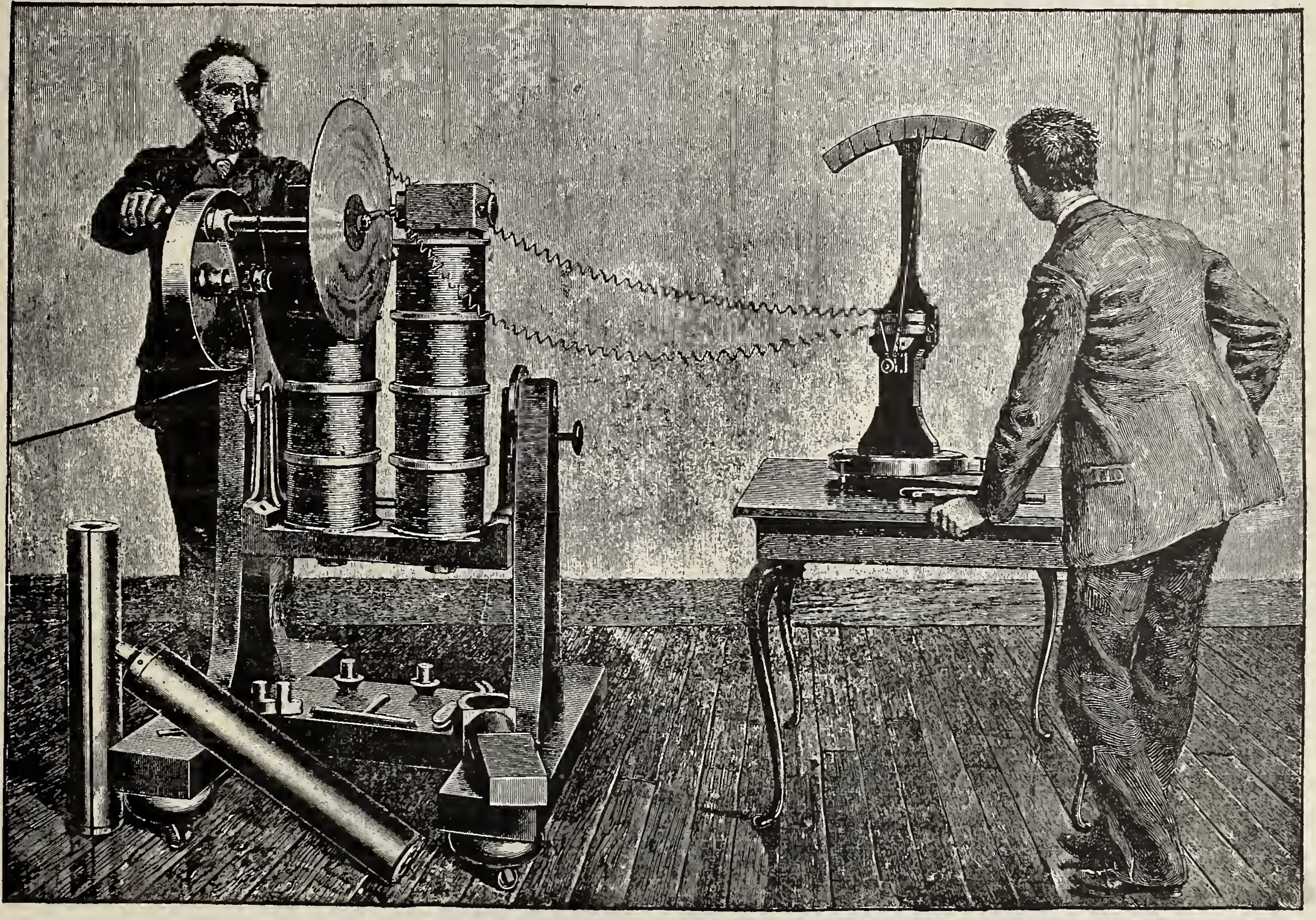
559,088. Telephone and Calling System. James G. Smith, New York, N. Y. Filed Feb. 11, 1896.

559,106. Telephone-Transmitter. Forest A. Ray, Springfield, Ohio. Filed Oct. 2, 1893.

559,348. Telephone-Switchboard. Henry M. Fisk, Austin, Ill. Filed May 27, 1895.

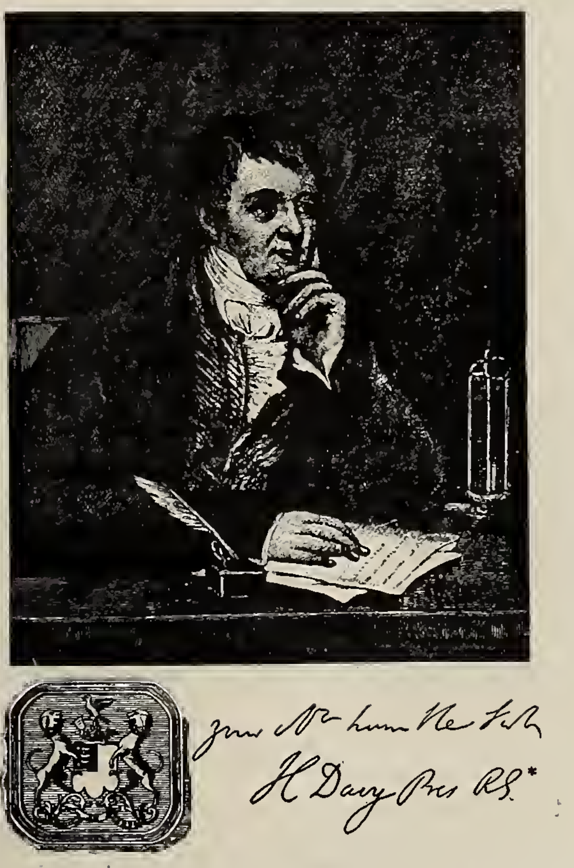
The Electrical Age.

VOL. XVII., No. 20. NEW YORK, MAY 16, 1896. WHOLE NO. 470



A GREAT DISK DYNAMO.

FARADAY'S EXPERIMENT.



The discovery of a new principle often hangs by a thread. Many inventions are the product of mere chance. Either may bring us to the shores of a new world, while the modest discoverer, like Columbus, still thinks he views the old. For many years, thousands of years in fact, amber held locked in its embrace a force that contained the elements of life and death. Its soul, the soul that the ancients spoke of, has not yet winged its flight. It has spread its benign influence over all civilization.

When the better period of scientific recuperation began to make its effects felt, those whose tastes and abilities were strongly developed at once made their presence felt in science, philosophy and art.

Dr. Gilbert, of the *Elizabethan Era*, began his investigations with the amber. From him stretches out a long line of illustrious names made famous by researches in electricity.

Sir Humphry Davy, with his "miner's safety lamp," on the basis of which the most modern gas burner, "the Welsbach," has been invented; and the arc light, which has added so much to the social side of civilized life, was succeeded by an apt pupil, Michael Faraday.

The dynamo is the undenied product of Faraday's genius. Not as it is today, but essentially so in general construction—depending upon the principles of electro-magnetic induction as laid bare by Faraday for its present development and commercial success.

There is in the history of all valuable inventions a rare and unheralded circumstance. An accidental combination, a swiftly passing idea caught and harnessed—this gives the world a new device. But a principle, a fundamental fact, is the discovery of genius.

Faraday demonstrated a principle that is worth more than a hundred million dollars today in its application.

In the labors and work which gave rise to his many discoveries none shine so luminously as those bearing upon this one great principle of induction.

Many were the experiments tried in his desire to view the subject from all standpoints.

Of them all, the operation of spinning a disk in a magnetic field and watching its retardation is most striking.

When Arago published his experiments, Faraday with care and insight repeated them. His desire was to explain the unusual deflection of a magnetic needle under which a copper plate is revolved.

He suspended a copper block between the poles of a powerful magnet and tried to set it spinning. It was impossible to continue the rotation. The influence at work reducing the motion was to his mind the result of an influence proceeding from the copper and induced by these circumstances. He discovered the existence of currents circulating in the copper block. The magnetism evoked by these currents causes the sluggish movement by the simple phenomena of attraction and repulsion. It was but a step to revolve a copper disk instead of a block in a powerful field and produce a current of definite direction. The illustration shows this experiment carried on on a large scale. It is a fruitful piece of mechanism. A perfectly continuous flow of electricity proceeds from it.

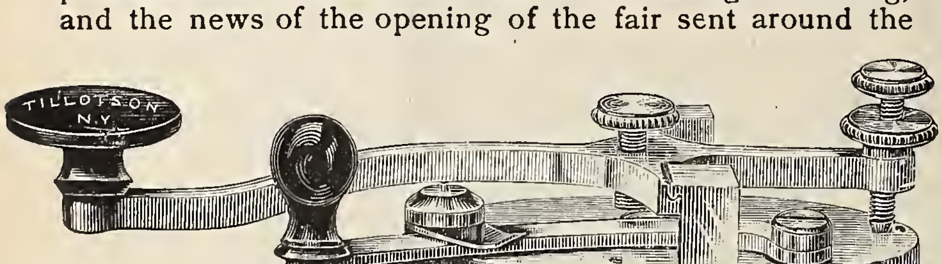
The steady growth of dynamo building dates from the time of Clarke. His machine was simply a magneto, but it served to show the practical importance of heavier and more improved types.

There is not much room at present for changes in the dynamo. Such innovations as occur will be those affecting some detail of trifling significance. The unexcelled efficiency of inductive devices of this order is due to the slight mechanical losses experienced. The armature rotating in the air meets with little impediment to free and rapid rotation. The losses of greatest importance, but even then of little value, lie in the machine itself. They are heat losses, hysteresis and eddy current losses. All combined, the subtracted power is not over ten per cent. in large machines, thus giving a ninety per cent. and in some cases a ninety-five per cent. efficiency.

What new type of generator will be the next outgrowth of inventive genius none can tell. Tesla has his new oscillator to give to the public. It may supplant the ordinary dynamo. We hear that a new carbon consuming battery has been invented whose efficiency is at least eighty per cent. Were such a cell within the compass of practicability, it would be sufficient to overthrow all large lighting plants and make them adopt this new means of producing electric energy.

THE GOLDEN VICTOR KEY

Which was used to open the great Chicago Fair was utilized for the same purpose by Governor Morton in opening the Electrical Exposition. There is no key in the world that has set in operation such tremendous enterprises as this. At its touch vast machines began running, and the news of the opening of the fair sent around the



world. The E. S. Greeley & Co., 5–7 Dey street, New York, might well be proud in the ownership of a key used by such distinguuised men as the President of the United States and the Governor of New York. This noted key will be used by Chauncey Depew to start a telegram around the world at the electric show, Saturday, May 16, 1896.

EQUALIZER SYSTEMS OF DISTRIBUTION.

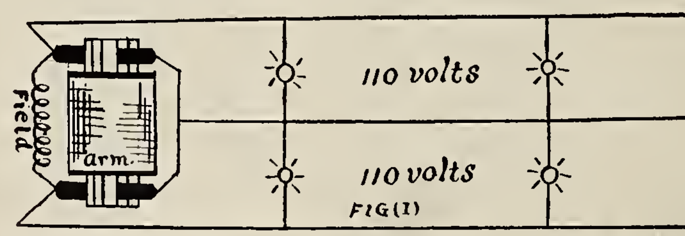
BY A. CHURCHWARD.

In preparing the following paper, the limited scope of which is indicated by its title, I have assumed that a three-wire system is supposed to be the only safe and reliable system of direct current distribution for motors and lights in our cities.

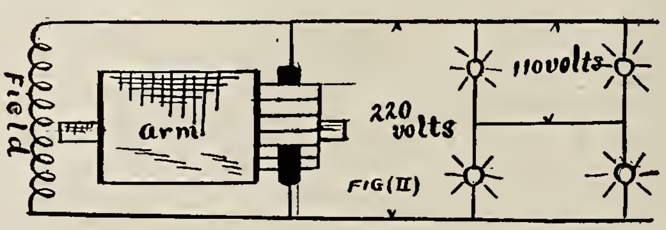
It is my intention to refer to the many methods that have been devised to accomplish the results obtained by the three-wire system, without the use of a divided source of electrical energy, and a compensating conductor connected to the point of division.

I now lay before you an abbreviated list of such methods.

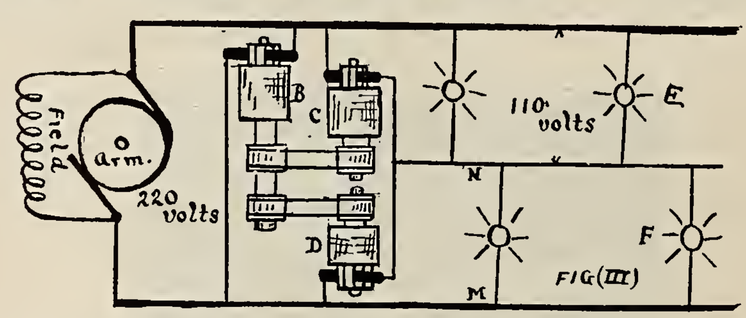
(I) Using a single dynamo with two commutators. Very



little would be gained by this, even if it did not infringe the above system, as one commutator on a large machine is all most people can put up with.



(II) I do not think that at this late day any one is likely to try the combination of a 220-volt dynamo and two sets of lamps connected in series by a wire.



(III) This time we come to a true system of equalizer distribution. We have only one generator of, say, 220 volts, "A," and two small machines, "C and D," capable of taking care of the unbalance due to turning off lights on either side of the circuit, and a motor, "B," connected to the two outside mains and driving the two machines, "C and D."

In this system our comparative loss is quite great at light load, as we have a constant loss due to the friction field current, eddy and foucault currents of three machines. Another disadvantage is the difficulty in keeping the system properly balanced, owing to drop in speed of motor with increase of load, drop in voltage of one of the machines, C or D, when running as a dynamo (due to armature reaction and C-R losses in the armatures); and, on the other hand, the load being taken off the voltage will be raised on the lightly loaded side.

The reaction that takes place is this, and will be found nearly the same in all equalizer systems :

When both sides of the circuits, E and F, are equally balanced the motor, B, runs free, only taking enough current to keep C and D up to the proper E. M. F. Should the load be changed, however, so that F had 20 amperes and E 10, then there would be an unbalance of 10 amperes.

An ammeter placed in the circuit at G would indicate 15 amperes as the amount of current to run the combination B, C and D.

Fifteen amperes would flow from the main (F) M to N, and the machine, D, would not act as a dynamo and supply the other five amperes.

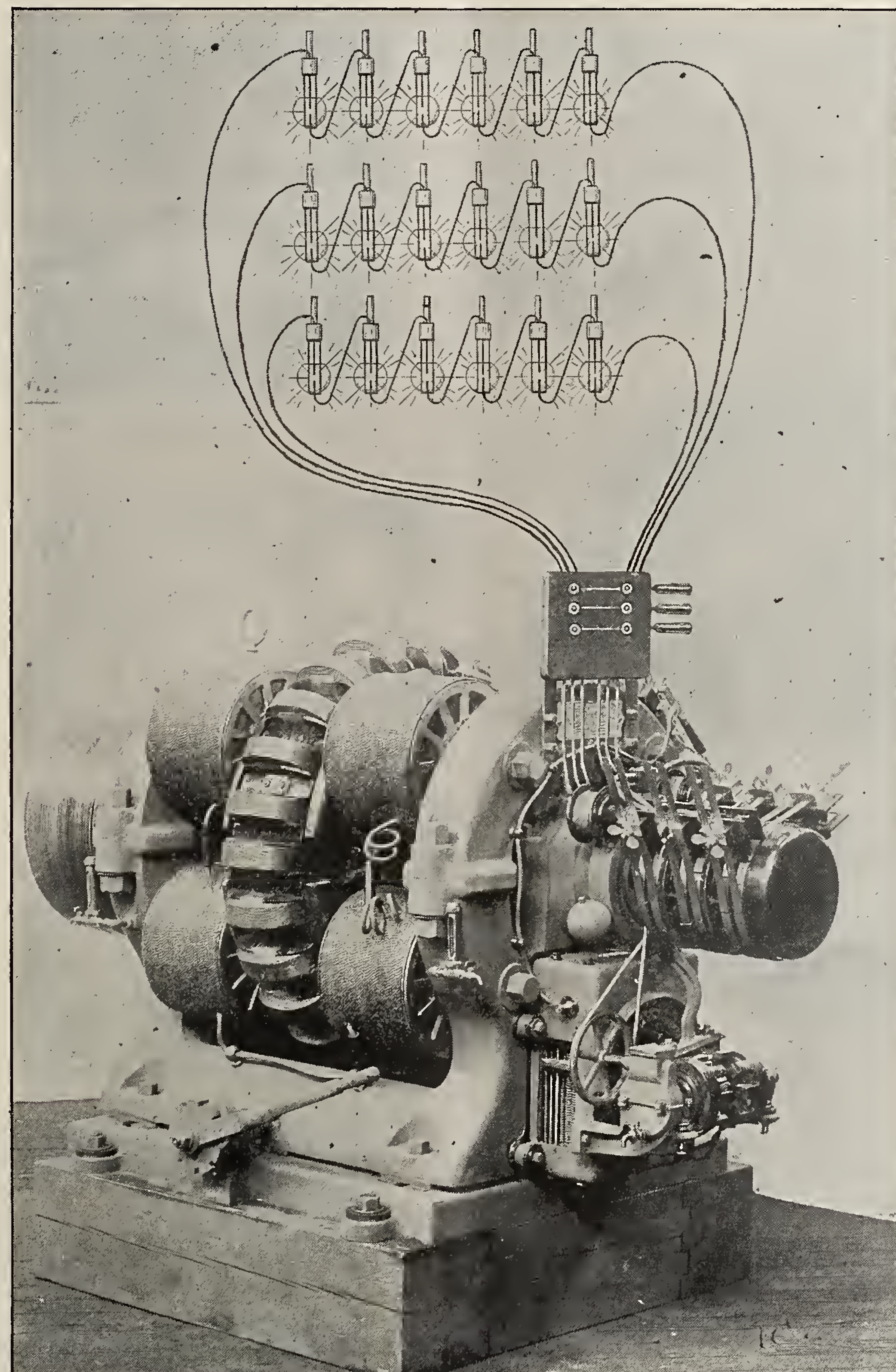
On the other hand the machine, C, would take the five amperes from the neutral, N, and run as a motor, helping to drive the motor, B.

Thus it can be seen that under ordinary conditions we can dispense with the motor, B, and couple C and D together, as per diagram. But by using the motor, B, a greater load on one side can be taken care of.

(*To be Continued.*)

What is undoubtedly the largest interior telephone system in the world is being installed by The Wilson-Bates Electric Company for the Hotel Matthewson, Narragansett Pier, R. I. The telephones for the work are being furnished by De Veau & Co., 32 and 34 Frankfort street, New York.

ON this page is an illustration showing a BRUSH MULTI-CIRCUIT SERIES ARC DYNAMO as exhibited at the electric show, 43d street and Lexington avenue, New York. There are three separate circuits running from the terminals of the machine. These circuits may also be run from the switchboard and can be thrown together, if necessary in, any combination. The greatest potential around the dynamo or circuit will be that of the



BRUSH MULTI-CIRCUIT SERIES DYNAMOS.

greatest circuit. The dynamo will run its full capacity with any distribution of load on the different circuits. Three-fourths of the load may be run on one circuit and one-fourth divided up between the other two circuits. The whole load may be run on any one of the circuits.

The advantages are absolute flexibility in the handling of circuits; reduction of high voltages on circuits run from large dynamos; use of large units with corresponding increase of efficiency, saving in floor space, oil, belting and attendants.

Is the Corona of the Sun an Electrical Phenomenon?

(*Continued from page* 202.)

The existence of this action was demonstrated by the experiment described in the paper cited above. Additional researches in this direction lead me to the conclusion that two discharge streamers tend to blow each other out, owing to the motion of the cooler gas between them, this motion being produced by the enormous heating effect of the discharge. The result is that the particles of the gas which at any moment form the path of a discharge are continually displaced (particularly in a discharge through a poor vacuum), and since every successive discharge prefers the particles through which the preceding discharge passed (for reasons given above), it follows that a sort of rotary motion is set up in the various parts of the discharge.

An additional evidence in favor of a translational motion along the paths of the streamers is furnished by the fact that all along the inside surface of the large glass bulb, which is below the tinfoil coating, there is a hazy luminosity which increases with the increase of the discharge, and which to all appearances is due to an accumulation of incandescent gas molecules which had impinged against and were reflected by the surface of the bulb.

Corona seen in 1871.

If the inside of the exhaust tube is lowered, so that it reaches the region of the discharge, it is observed that from time to time the incandescent gas shoots through this tube toward the stopcock way out of the bulb.

Effect of a Blast an a Discharge Streamer. Granting that there is a translational motion along the path of the streamer, it follows that a rectilinear streamer may be transformed into a curved one by imparting to the gas in each part of its path a component velocity perpendicular to its original velocity. This inference was confirmed by the following experiment:

Two bulbs coated with tinfoil on the outside (the electrodes of the system) communicated with a reservoir (which I call the *principal reservoir*) by means of glass tubes of narrow bore. An L shaped tube with a small orifice was fitted by means of a rubber stopper into the neck of the reservoir. By means of this tube and the tube the *principal reservoir* communicated with two other reservoirs, which I call the *external reservoirs.*

The *external reservoir* communicated with a mercury pump. When the exhaustion had reached the point at which a steady rectilinear discharge could be forced from electrode to electrode, a stopcock connecting the outlet tube to its external reservoir was shut off and the exhaustion continued until a good vacuum was obtained in the external reservoir. The discharge was then started. It was a perfectly steady, narrow, rectilinear column of crimson luminosity, surrounded by a phosphorescent ellipsoidal column. But as soon as the above mentioned stop-

Corona as seen in 1878 in Texas.

cock was turned on, the blast coming from the orifice played up the column, and the rectilinear path became curved at the point where the blast was acting. The discharge acted as if it bent around to get out of the way of the blast. The observation that the effect of the blast upon the phosphorescent column was incomparably stronger than upon the crimson column needs no comment. The weaker the discharge the stronger is the effect of the blast, and *vice versa.* The effect of a blast upon the oscillatory spark discharge of a powerful Leyden jar battery is not perceptible.

In discharges through very poor vacua the heating effect is very unequally distributed throughout the vacuum jar. The temperature at certain points is enormously higher than at others. The result is that a very violent motion of the gas is set up, which motion may sometimes, on account of the effects pointed out in the last experiment, produce streamers of double curvature.

During an experiment with the apparatus as given, which I performed on Feb. 8, 1892, before the astronomical section of the New York Academy of Sciences, a leak occurred, so that the vacuum was exceedingly poor by the

Corona as seen in 1868.

time I was ready to start the discharge. Finding that the discharge gave no sign of starting, I risked to turn the whole power of the 10 H. P. alternator on the induction coil. Long sparks shot immediately from almost every point of the edge of the tinfoil. The discharge between the brass sphere and the tinfoil looked like a black-faced Medusa with fiery serpents dancing all around her head. On repeating this experiment, I found that in very poor vacua the discharge streamers very often assume the form of spirals of very long pitch.

All these phenomena suggested to my mind a very strong similarity between the streamers of an electrical discharge through poor vacua and those of the solar corona, and for the purpose of pointing out this similarity to others otherwise than by verbal description only, I resolved to photograph these discharges under conditions similar to those under which the solar corona is observed. Photographs 1, 2, 3, 4, 5, 6 are the result.*

The discharges were obtained with the apparatus given in the previous case. The only additions were that a circular tinfoil disc was pasted on the outside of the large bulb, in the line of sight between the camera aud the brass sphere. The diameter of this disc was about equal to that of the brass sphere. Also, the inside surface of the large bulb which formed the background of the brass sphere was blackened by means of camphor smoke, to avoid reflections. The discharge in Fig. 1 (see sketches) is that of a good vacuum (about 2 mm.); the succeeding ones represent discharges in poorer vacua, the pressures varying between 2 mm. and 60 mm.

The bearing which these experimental results may have upon the theory of the Solar Corona I prefer to leave to others to decide. That they may prove a suggestive guide in the study of solar phenomena seems not unreasonable to expect.

I am greatly indebted to Professor John K. Rees for the interest which he took in my work, and to Mr. Mann, of the Columbia College Observatory, for the very valuable service which he rendered to me in photographing the coronoidal discharges.

Department of Electrical Engineering,
Columbia College.

SINGLE-PHASE SELF-STARTING SYNCHRONOUS MOTORS.

BY F. H. LEONARD, JR.

(*Continued from page 232.*)

IN such motors the power factor, which is the ratio of the real to the apparent energy, varies from 20 to 80 per cent. That is to say, if the motor has a power factor of 50 per cent. there must be double the current furnished that is actually required to do the work, and while half the current is wattless yet it uses up capacity in generator, transformer and line wire, with energy consumption due to C^2R losses in each, and in long distance transmission the impedance (which is the only drop plus that due to the induction of the line, and which varies with the current and frequency) cuts such a figure as to make the expense for copper large in order to keep the working electromotive force within proper limits.

Pacinotti's discovery of the reversibility of a dynamo applies to alternating current machines as well as direct, except that the alternating current generators, when used as motors, must be brought to synchronous speed before it will fall in step with the generator, and further, must have its field excited with direct current usually from a separate source. It will then operate as a motor, and is the most satisfactory motor that can be produced when constant speed is required. Its efficiency is the highest; quite as high as that of direct current motors of equal capacity, while the regulation is perfect. So long as the generator with which such motor is connected runs at a uniform speed, the motor must run at a proportional speed, dependent on the ratio of the poles to the alternations; every impulse of the generator advancing the armature of the motor one pole. The motor cannot change its speed any more than if it were mechanically geared to the generator, unless it is overloaded to a point where it is impossible to carry the load, which point is usually about 50 per cent. in excess of the normal capacity of the motor. This is accomplished without the introduction of any lag or power factor, the lead being practically non-inductive—like a load of incandescent lamps—provided the proper excitation is maintained. Furthermore, by over excitation the synchronous motor may be made to perform the office of a condenser and compensate for lag or inductive lead, and can be carried so far as to induce a negative lag or lead, at the same time raising the electromotive force of the line.

The drawback to the single-phase synchronous motor has heretofore been that it could not be started without some other source of power and would not carry its load up to speed. Motors are now made in which this is entirely overcome. They start up under load and can be specially wound to give much greater torque in starting than when running in synchronism.

This brings us back to the two simple, well-known principles before referred to, which are combined in this motor—the principle of the ordinary alternating current synchronous motor with that of the direct current motor or generator. The armature has two distinct windings; one, a distributed winding connected to a commutator, similar to that of a direct current motor or dynamo, which in this motor is used for starting and afterwards for exciting the field. The other winding is of the shuttle type, wound so as to concentrate distinct and regularly alternating poles in the armature, and performs the regular work of rotating the motor armature, advancing it from one pole to the next with each impulse of the generator.

An ordinary double throw-switch on top of the motor is used in starting, there being no resistance or other complicated device, as the self-induction of the windings is sufficient to choke back any abnormal flow of current.

(*To be Continued.*)

* Electrical Age, March 28, 1896.

Interesting Facts in Science.

"Flight and Flying Machines."—A lecture on this subject was given recently at Woolwich, by Dr. Bryan, F.R.S., before the Royal Artillery Institute. In describing the difficulties of learning to fly, even if we were in possession of apparatus suited for flying, he referred to the flight of birds, and showed that the difficulty became greater in proportion as the size of the flying body increased. This applied similarly to mechanical apparatus, and he had adduced an approximate rule connecting the size with the power required to lift it. His rule is, that the power required per unit of weight varies as the square root of the linear dimensions. As Mr. Maxim had raised a large machine off the ground by means of aëroplanes, he concluded that a small machine capable of carrying one person could also be sustained in flight by mechanical means. Any difficulties that remained to be surmounted were connected with the stability and control of the machine. He referred to the fact that Herr Lilienthal, in Germany, and Mr. Pilcher, in England, had been practicing in this direction, making soaring flights with artificial wings from eminences. He looked forward with confidence, he said, to the time, not very far off, when by combining the skill attained by those two experimenters and the mechanicai ingenuity of Maxim, the problem of artificial flight would be fairly solved.—*Trade Journal.*

Gas and Electricity.—Siemens found that an electric arc light of 4,000 candles radiated 142.5 thermal units in a minute, while to produce this light by gas would require 200 argand burners, which would emit 15,000 units, or over a hundred times as much.

Power Changed Into Heat.—About three million foot-pounds changed into heat in the electric arc will affect our eyes six times as powerfully as sixty millions changed into heat in a gas burner.

Hagerstown, Md.—The Hagerstown Electric Railway will be extended to Williamsport.

ROENTGEN RAYS.

High Frequency Currents and Bacterial Toxines.—It is reported that M. M. D'Arsonval and Charlan have proved by experiments that currents of high frequency attenuate the bacterial toxines. Toxines thus attenuated increase the resistance to infection of animals into which they have been injected.

The Transparency of Carbon.—According to M. Meslans, carbon is very transparent, as well as all its purely organic compounds; but the addition of a mineral element, metal or metalloid, increases their opacity considerably. It appears that this is due to a certain atom in the molecule, which imports into all its combinations the property of absorbing the X rays; thus lead and its compounds remain opaque in all possible combinations, and it is to its presence that crystal glass owes its great opacity; this latter substance is incomparably more opaque to the X rays than other glasses of the same composition except that they contain no lead.

The Test for Diamonds.—The opacity of certain bodies to the X rays forms an easy means of identifying them. Thus Gascard and Buguet have found that diamonds are much more transparent than their imitations. The same is true for jet and other stones employed in jewelry.

The Penetrability of all Bodies.—Oscillations of very short wave length ought to traverse all bodies; in fact, when the length of the wave approaches the size of the molecule, matter appears for the movement of the ether with a certain discontinuity, and the wave traverses it without much difficulty. At the same time absorption, reflection and refraction ought to disappear.

Air Made a Conductor.—According to Prof. J. J. Thomson, of Cambridge, the property which the X rays possess of discharging electrified bodies is due to the fact that they make the surrounding medium a conductor. This quality of the medium persists during a short space of time. This is shown by directing upon the electroscope the air which has been traversed by the rays. The discharge still takes place, which shows that the gas has experienced a modification of a chemical nature.

Success Where Roentgen Failed.—Galitzine and de Karnojitzky have succeeded with an experiment that Roentgen attempted with negative results. On passing the X rays through crossed tourmalines, the Russian physicists have observed a well marked diminution of the action of the rays. They conclude from this that the rays are polarizable, and that the direction of the oscillation is transversal.—London *Electrical Review.*

THE EVOLUTION OF THE ARC LAMP.

L. H. ROGERS.

(*Continued from Page 132.*)

NO sooner had Faraday announced his discovery than scores of inventors and experimenters began to construct and perfect dynamos. Some great mind like Faraday, or Roentgen, lets down the bars to the Elysian fields, and thousands rush in and stake out all the choice corner lots. These swift-footed inventors, however, are necessary to the evolution of an industry.

Beginning with 1832, one dynamo followed another in rapid succession. Each successive machine embraced some new device or new idea overlooked in its predecessor.

Improvements also began to be made in the device, which transformed the electric energy into light. Davy's light, although blinding to the eye, became wearisome, simply as an experiment. It was found that the pieces of charcoal were gradually consumed as they were burned—the one attached to the positive end at the rate of about twice that at the negative end. This led to the necessity of providing some means of feeding the pieces of charcoal towards one another as they wasted away. The pieces of charcoal themselves were improved. They were hardened and baked, and thereafter called carbons.

Thus began the arc lamp on its long, rough journey towards perfection. The first efforts were very crude. The electric current passing through the lamp was utilized to cause a screw to revolve slowly. At the end of this screw was attached the positive carbon, which in this manner was fed towards the lower or negative carbon.

It is easily seen that the nearer the carbon points approached each other the less became the resistance, and the greater became the flow of the current. Likewise the greater the distance between the carbon points, the greater the resistance, and the less the flow of the current. This ebb and flow of the electric current provided magnetic power of varying strength, which was early seen could be utilized to operate the mechanism to feed the positive carbon. The disadvantage of this, however, soon manifested itself in the fact that as the current was augmented and diminished by the proximity and separation of the carbon points, the current in the line itself was proportionately affected. This made the operation of two or more lamps on the same set of wires impossible, for the reason that the carbons in the different lamps could not be depended upon to feed at the same instant, as well as the effect on the regulation of the dynamo.

The operation of more than one light from one machine was therefore attended with difficulty from the time of Faraday's discovery in 1832, up to 1875. Some little success was obtained during this period by running a set of wires from the machine to each lamp desired to be operated, though no illuminating to any extent was done in this manner except as a laboratory experiment.

About the year 1875 it occurred to a young electrician, Charles F. Brush, living in Cleveland, that if he could construct a device for an arc lamp which would regulate the feeding of that lamp without affecting the main line, it would then be possible to operate any number of lamps on one circuit, as the current momentarily required to operate the feeding mechanism in any given lamp would leave all the others undisturbed. This was a bold idea, and required inventive genius of a high order to carry it out.

Up to this period a magnet had been employed in the lamp mechanism, which consisted of a coil of wire wound around a hollow spool, into which was inserted an iron core. When the current was switched on, the action of the coil was to draw the core into the spool. This movement provided means for raising and lowering the upper carbon. Mr. Brush used two spools for added strength. The normal path of the current was around these two spools (in parallel) to the carbon and down through the carbons and then to the negative terminal. He, however, constructed another possible path for the current.

(*To be Continued*).

TRADE NOTES.

Depew, N. Y.—The Gould Coupler Co. is adding a two-story office building to its plant. It will be heated with hot water and lighted with electricity.

The Electrical Age.

Established 1883.

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CONTENTS.

TRADE.

People like to feel each others' pulses nowadays. A man often imagines himself ready to make money because his neighbor does. It is strange that this does not always follow. To be able to judge of the condition of trade is a great art. Those that do become rich; we have nothing to say about those that do not. If a new enterprise turns out successful, it is often due to the fact that they collect bills about as fast as they do business. If they should unfortunately become too one-sided and do too much business, they might not have time to do anything else.

Those whose money is invested in electrical manufacturing have a great habit of becoming very despondent, and then without the least warning suddenly coming to the conclusion that there is nothing to be melancholy about. It is very desirable that a man's mind should be elastic in this respect.

Not only have others the trouble and bother of collecting bills, but they are under the necessity like yourself and thousands of others of paying bills. A bleak prospect frequently arises when our preparation for this solemn event is incomplete. At present the sky seems to be brightening. Even if the signs fail there is still time to work, to act, and to succeed.

THE ARC, INCANDESCENT AND PHOSPHORESCENT LIGHT.

So many illuminants have entered the field of competion that it is not a matter of ease to select the best. All the known means of producing light since early ages are in use today. The hovel still reflects the glow of dying embers; and in the poor man's home the dripping candle sends its yellow flicker into the thick darkness. These are not the very oldest means known to man. The use of oil dates back to Bible days; it supplied the light to the sanctuary. The volcanic gleam of the mountain-top was undoubtedly the first.

The later age produced new methods that met with immediate application. Gas not been used in the home one hundred years as yet. The arc and incandescent lamp are not thirty years old. The latest means of producing light, the vacuum-tube, may replace them all. Our illuminants have an efficiency so low that it is shameful to mention it. None but the phosphorescent tube have more than five per cent. efficiency. The gaslight loses .99 of its energy as beat, the incandescent light .97, and the arc at least .95. What the real efficiency of a luminescent vacuum tube is, it is difficult to say. The light, giving property interests us most; in fact, it is the only point worth considering.

A phosphorescent tube cannot use much energy, but there may be heavy losses in getting the power to the tubes. In this respect it is at present likely that the other electrical illuminants are superior.

CLOSED GLOBE ARC LAMPS.

The incandescent light is being improved every day. Its usefulness has increased and in the home it has found a secure resting-place. It is not long since the arc was an object of commiseration. Its defects were so plainly manifested, its action so deficient, that none could have hoped for a favorable change. The arc lamp, however, has passed through its worst days. Many persistently refused to forego its use. Others were content with a faith and patience that approached sublimity to endure it. It survived the worst days of abuse; it soon left the dangerous realm of high tension currents.

Today the public hall requires it and the galleries of art and science, the monuments of municipal honesty are bright with the whiteness of its light.

It has been a great victory to arc lamp exponents to thus see its prosperous survival. The closed globe shut out the chances of conflagration and increased its life to more than one hundred hours. It is almost a hybrid type, a cross between the open globe arc and closed globe incandescent. There is no reason why this new and improved arc lamp of the present day should not burn six hundred or even one thousand hours. A system of relay carbons will answer the purpose and help to complete an achievement in lighting that would stand unexcelled.

In a paper recently read before the Academy of Sciences in Paris, France, on the presence of sodium in aluminium prepared by electrolysis, M. Henri Moissan showed that electrolytic aluminium contains generally from 0.1 to 0.3 per cent. of sodium, and that it is owing to the presence of this impurity that the metal is easily attacked by water. Aluminium should always be used alone and pure, as it really forms electric couples with every other metal, and is then easily attacked by water.—*Trade Journal Rev.*

A Child Touching the Sun.—Prof. Mendenhall says that if we could imagine an infant with an arm long enough to reach the sun and burn himself, he would die of old age long before he could feel the pain, as, according to the researches of Helmholz and others, sensation travels along the nerves only at the rate of about one hundred feet a second, or 1637 miles a day, and would accordingly need more than 150 years to cover the distance from the earth to the sun.

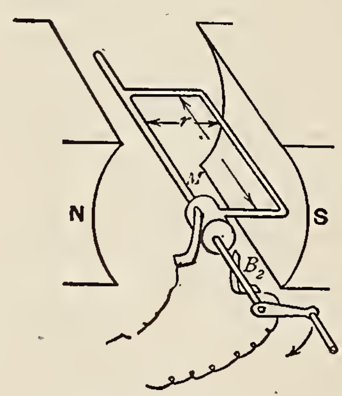
THE DYNAMO AND MOTOR.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

Motion of Magnet to a Coil.—The magnet may be moved toward a coil, forming a closed circuit, or the coil towards the magnet, as shown in the last sketch.

In either case the direction of the induced current is such that power is consumed. It is to be understood that no resistance is felt if the wire is open, but if closed the law of Lenz regarding the induced currents, their direction and reaction, becomes evident at once. When the coil is open an electromotive force is set up in it. The current does not flow, although the potential at each end would cause it to at once were the circuit closed. The movement of the coil brings it within the varying influence of the lines of force of the magnet. It passes when approaching the pole from a weaker to a denser field; on leaving, from a denser to a weaker. If the magnet were very big



SIMPLE DYNAMO.

and strong, and the coil large, the labor of quickly moving it would be severe. The reaction set up between the magnet and coil, which causes work to be done, is entirely magnetic. The lines of force encircle the coil and are cut; a current is set up whose magnetic effect forces us to expend energy in continuing the motion.

The entire phenomenon is therefore simple enough from this standpoint—the attraction or repulsion of unlike or like poles. This final effect always occurs, the induced current having a direction which can be predetermined by this means. A coil approaching a north pole will have induced in that side of the coil nearest the pole a current flowing against the hands of a watch. A north polarity develops at that end and continues as long as the coil is moved in the neighborhood of the magnet.

The current which produces this magnetic repulsion reverses in direction when the movement away from the magnet begins. The flow of an induced current is dependent upon the direction of motion as well as the polarity of the magnet.

In the motion of a magnet to a coil the induced current opposes the further movement of the magnet.

Motion of Magnet from a Coil.—When a magnet is moved away from a coil, or lifted out of its embrace, the induced current flows in such a direction that resistance is felt. This is very noticeable with large magnets and coils; it can be indicated by means of a galvanometer with the very smallest. A retardation is felt, a sort of viscous resistance, which seems to be a dragging back of the magnet. It is again traced to Lenz's law for interpretation, and may be considered as directly due to a strong magnetic attraction which at once asserts itself. This attraction can only be due to unlike poles; it therefore follows that it is caused by a current of opposite direction to the first. The motion of a magnet from a coil induces a current which retards the further movement of the coil.

Simple Dynamo.—The principle just presented is made use of in the dynamo for the generation of heavy currents of electricity. Instead of a single coil moving back and orth in front of a magnet we have a succession of coils rotating on a shaft in a magnetic field. Each length of wire acts as an *inductor*, producing electromotive force. The pressure developed depends upon three factors:

Lines of Force,
Inductors,
Speed.

The rule is as follows: If a wire rotates in a magnetic field, cutting one hundred million lines of force per second, an electromotive force of one volt is developed.

With two wires twice as much would be created, or with one-half the field and four wires. This rule is applied to dynamos for the calculation of pressure.

The method employed is not confusing or complicated, as given below:

$$\text{volts} = \frac{\text{number of inductors} \times \text{lines of force} \times \text{revolutions per second}}{100{,}000{,}000}$$

Taking the case of a dynamo of this construction,

Inductors = 100
Lines of force = 4,000,000
Revolutions per second = 25

$$\text{Electromotive force} = \frac{100 \times 4{,}000{,}000 \times 25}{100{,}000{,}000}$$

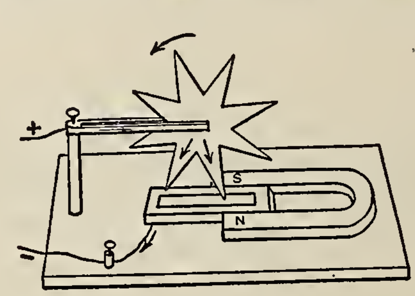
Electromotive force = 100 volts.

The number of turns on an armature differ according to its use. For high pressures in arc lighting there are many turns; for low pressures, such as plating, very few. Between these two classes of machines are those used for incandescent lighting. Many changes are noticeable today in the construction of dynamos. The two groups called

Bipolar or two-pole and
Multipolar or many poles

comprise all made with the exception of special types, some of which are built like Faraday's disk and others for alternating current work.

The Commutator.—The piece of mechanism which is used for the purpose of sending all the impulses out in one direction is called the commutator. It has been known in the past by another name, such as "rectifier" or "collector." As the armature rotates, the wires upon it individually generate a current; this is collected at the commutator bar connected to each one and received by the brush. One brush takes all positive impulses; the other all negative. As an inductor passes in front of one pole the current flows in an opposite direction to that it takes in passing in front of



BARLOW'S WHEEL.

the other. This accounts for the use and necessity of a commutator.

Barlow's Wheel.—If Faraday's disk is taken and allowed to dip into a trough of mercury connected to one wire, the other going to the shaft, and a current be applied, the wheel will rotate and perform all the functions of a motor.

This wheel, which is simply an application of Oersted's principle, is the type of all modern motors.

(*To be Continued.*)

Madison, Wis.—The controlling interests in the plants of the Madison City Gaslight and Coke Co. and the Four Lakes Light and Power Co., owned by substantially the same Madison men, has been sold to a syndicate, represented by and associated with Emerson & Co., bankers of New York.

RECENT DEVELOPMENTS IN VACUUM TUBE LIGHTING.

A paper presented at the 105th Meeting of the American Institute of Electrical Engineers, New York, April 22nd, 1896.

BY D. MCFARLAN MOORE.

(*Continued from Page* 238.)

FIGURE 19 is another of peculiar form—an unusual density of white light inside the convolutions of the spiral.

To determine whether there was any appreciable heat at the centre of an intense pencil of light, a number of lamps were constructed in which various substances were placed at the point of greatest density of light, as in Fig. 19, but in no instance was the substance affected in any degree whatever.

Following out this idea a little further, there was inserted

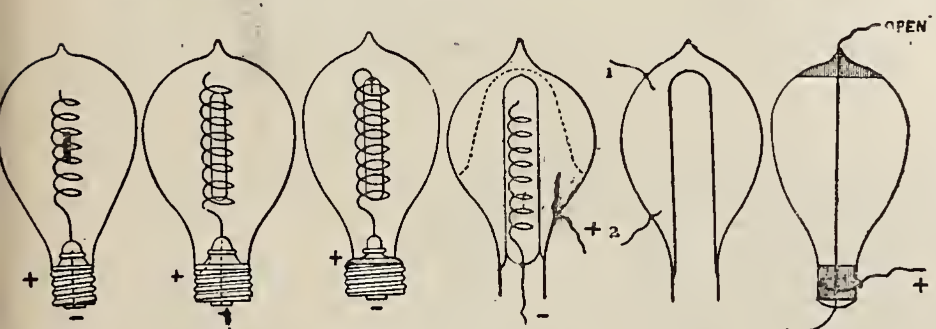


Fig. 19. Fig 20. Fig. 21. Fig. 22. Fig. 23. Fig. 24.

a small glass tube containing air properly rarefied in the centre of a spiral, as in Fig. 20.

But the inside of the small tube remained dark; nevertheless, the glow outside of the spiral, dark space and other phenomena, even to the tufts of light between some ofthe convolutions of the spiral, are the same as those in a similar lamp without a tube inside its spiral.

Another lamp was then made the same as the last, except the tube inside the spiral has a platinum wire extending into it, which wire is electrically connected with the spiral (Fig. 21). Of course, the small tube was tried separately before being placed in the lamp bulb, and it filled with a white glow. But after the lamp was completed it refused to give any light; the glow outside the spiral, however, was the same as though there was no inner tube present.

Hoping to get a lamp with almost no metal in the light-producing vacuum, the lamp shown in Fig. 22 was constructed—the spiral is within a separate tube. When tried, a tuft of light appeared in the top and bottom of the small tube which was surrounded by a faint glow, the outlines of which are shown by the dotted line.

The next step was to do away with the inner vacuum and construct a bulb as shown in Fig. 23. When a spiral was inserted in the tube and connected to the negative pole, the positive being either 1 or 2, a dark space an eighth inch deep surrounds the tube, beyond which a faint pinkish glow appeared filling the bulb. The phenomena known as "after-glow," which is sometimes noticed in evacuated bulbs after having been subjected to an electrostatic strain, I have been able to obtain, but very seldom. (Fig. 24.) However, this bulb could be picked up and carried around the room, but every time it was picked up after being laid down a discharge resulted, which, being repeated three or four times, dissipated the glow entirely.

From a tube containing two parallel wires, shown in Fig. 25, but with a low degree of exhaustion, the glow was entirely absent, but instead, brilliant, flaming yellow discharges completely filled the space between the wires, which was over half an inch wide and about two feet long.

At the beginning of the lecture your attention was called to the great similarity existing between the field of force of a "cold light-giving" conductor in a partial vacuum, and that of a conductor conveying a current in the open air. Care, however, should be taken to note that the light from the rarefied atmosphere is due to electrostatic and not electromagnetic phenomena.

For example, I have here a powerful electromagnet which I connect directly across the lighting mains and,

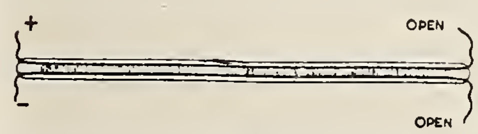


Fig. 25.

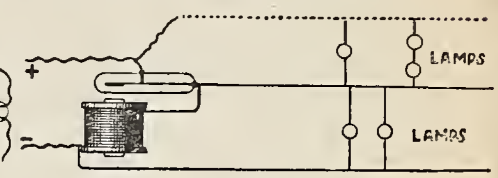


Fig. 26.

therefore, it is one at whose centre or core the electromagnetic field is very dense. When this tube, which has a diameter the same as that of the core of the magnet, has about half of its length passed through the centre of the magnet, no light whatever results. If, however, but one terminal (the other being free) of this same magnet be connected to the vibrator, immediately the tube gives forth light.

Referring again to the subject of connections, Fig. 26 shows the light connected around the terminals of the magnet; it also can be connected with equal results around the break or spark gap as shown by the dotted lines. Your attention is called to the fact that lamps of this kind will operate equally well, whether connected in multiple or in series, provided the area of the negative electrode is about the same in each; if not, that one in which the negative electrode is of the greatest area will alone light up.

If a single bulb of small size be connected to a circuit of considerable induction, a well-defined discharge is liable to occur which will ruin the lamp.

In Fig 27 an inductive resistance is distributed with each lamp, making the system of distribution self-regulating, that is, the turning on or off of lamps will not affect the brilliancy of those burning steadily.

Referring again to the diagram of circuits showing the system in its simplest form: If good results are to be obtained, the magnet must be designed and constructed with the greatest care. Its duties are two-fold; first, to give the vibrator its mechanical motion, and second, to act as an inductive resistance. The iron core must be proportioned to the conditions of the circuit. If there be too much or too little the light suffers; but a certain amount of iron

Fig. 27.

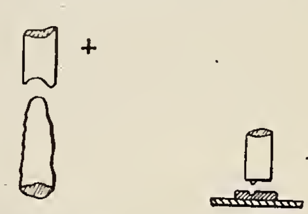


Fig. 28.—Electric Light Carbon. Vibrator Contact Points.

should remain, in order that the magnet have sufficient power to vibrate the armature. Similarly if there be too many or too few turns of wire on the magnet, the light is decreased. From this it is evident that vibrators of different rates will not be suitable to the same magnet. However, even when a vibrator is connected to a suitable magnet and circuit, and produces a good light, it can be further improved by "tuning the circuit," that is, altering its self-induction by varying the amount of iron in the magnet's core. It should also be stated that by this means a maximum light is obtained from a minimum current. In order that the time constant of the magnet be a minimum, and to ensure rapid action, the magnets should be short and thick. Large induction coils cause the tubes or lamps to give forth but little light, while a small magnet, whose length of wire is not $\frac{1}{100}$ that of the induction coil, will cause the tubes and lamps to light up brilliantly.

It is interesting to note that with a comparatively few turns of wire a very small one-volt battery will give quite a strong glow. This glow can be intensified by using a secondary coil.

Although the various lamps that have been described are of great interest, nevertheless the very nature of lighting by luminescent gas is such, that it is far more applicable to radiate from sources of considerable area than from units of light of small area. The best method of obtaining light from a large area is by the utilization of tubes of considerable length, instead of small bulbs. The light of these tubes should be entirely free from the very objectionable striations always present when interior electrodes are used; but these striations are entirely obviated by using exterior electrodes. They may be metal caps on the outside of the tube, or preferably merely coatings of metallic paint. Such tubes can be made up in almost any lengths, and can be bent into a great variety of forms, making them suitable for exquisite decorative effects. Under this head can be mentioned the fashioning of tubes in the form of letters, which may be used as electric signs.

Permit me to call your attention once more to the key of the whole system, viz.:—repeated interruptions of an electric current in a high vacuum.

The simplest method of accomplishing this object is to hermetically seal within a glass tube a vibrator of ordinary form, but its exact construction to give the best results has been a matter of tedious experimentation and study. The very slightest alteration in the dimensions of almost any of its parts—such as the length, width and thickness of the spring, or its method of mounting, or the position of the contact points, or the thickness or diameter of the armature, will cause it to be a very good or a very poor vibrator. Again, the operations of the glass-blower had to be watched most carefully. Only certain kinds of iron and steel were selected, to avoid occluded gases, and even then they must undergo a special treatment before being fit for use. The selection of suitable contact points has also been a large field for research. Nearly all known conductors have been tried, and many interesting facts have developed in this connection, not only so far as the direct action on the various metals in vacua and various gases is concerned (and this in several instances is the reverse of the phenomena in open air), but also with reference to the electro-deposition or electrolytic action that takes place. For instance, as is well known, the positive electrode is the one which disintegrates most rapidly in the open air, and its apex is usually concave. This is probably best shown in the ordinary direct-current arc lamps. If aluminum, or any soft metal of comparatively low fusing point, be used as contacts in a vibrator, after about a day's run an examination shows that the shape and condition of the contacts is just the reverse of the way they appear after use in the open air. That is, the positive terminal looks like the negative and the negative like the positive. (See Fig. 28.)

(*To be Continued.*)

New York City.—Gilmore & Tompkins, proprietors of the Academy of Music, have decided to build a large place of amusement at 60th street and the Boulevard, fronting on the circle. Work on the new building will be begun about June 1.

Lansingburgh, N. Y.—The Beason Electric Co. Capital, $100,000. Directors, William M. Lea, Samuel Bolton, Jr., Edward Van Schoonhoven of Lansingburgh.

Cleveland, O.—The directors of the Cleveland, Wadsworth & Southern Electric Railway Co. have decided to increase the capital stock of the company from $10,000 to $100,000, in order to facilitate the building of the road.

Baltimore, Md.—The Govanstown Water & Electric Light Co., incorporated by Lawrence B. McCabe, A. D. Clemens, Jr., H. M. Walker, Leander Foreman and others. Capital, $50,000.

THE COMMERCIAL VALUE OF ACETYLENE GAS AS AN ILLUMINANT.

BY LOUIS A. FERGUSON.

(*Continued from page 230.*)

THE carbons are raised and lowered by means of a chain winding on a drum operated by a wheel in the dynamo room, so that the energy expended in the production of the arc is maintained constant during the process of manufacture of the calcium carbide. Having thus seen the method of producing the electricity and its application to the electric furnace, we will now pass to the process of manufacture of the carbide. The carbon used in the process at Spray is Pocahontas coke, having a nine per cent. ash. The coke is conveyed to a hurricane mill, where it is ground to a fine powder and then put with the lime into a revolving mixer, by which it is thoroughly mixed and prepared for the electric furnace. Theoretically the proportions of lime and carbon necessary for the production of 100 pounds of calcium carbide are 87½ pounds of lime and 56¼ pounds of carbon. These combine according to the formula before mentioned, $CAO + 3C = CAC_2 + CO$, 37½ pounds of carbon combining directly with the metal calcium forming calcium carbide, and 18¾ pounds combine with the oxygen of the lime, forming carbon monoxide gas, which passes off from the furnace.

Nearly twelve months ago, on May 15, 1895, at Spray, N. C., with the described plant, the writer, together with Mr. George O. Knapp, of Chicago; Mr. T. L. Willson and Major Morehead, of Spray, N. C., carried on a test to show the actual production of calcium carbide per horse-power per day and the volume of acetylene obtainable per pound of carbide. The coke and lime were prepared in the manner described, the mixture containing 800 pounds of air-slacked lime and 390 pounds of powdered coke, making the total weight of mixture 1,190 pounds. Of this mixture 180 pounds were unused, leaving 1,010 pounds, which were delivered to the furnace. The test run was for a period of three hours, during which the mixture was fed into the furnace by shovel, as required, and the material stoked regularly. The current used varied from 900 amperes to 1,200 amperes, as extreme limits, but being kept very regularly at about 1,000 amperes, the voltage varying from 90 to 104 at the extreme, and being kept fairly constant at 100 volts. Readings were taken approximately every ten minutes during the test, and from twenty-three readings the average showed 1,000 amperes and 100 volts, or an average consumption of energy at the terminals of the furnace of 100 kilowatts during the entire run of three hours.

After the current is turned on and the arc made the carbide begins to form on the bottom of the furnace under the upper carbons in the shape of a block, and as it forms it is necessary to raise the upper carbons to maintain the proper arc, the current passing from the carbons in the form of the arc to the carbide below, the latter now constituting the other pole of the arc and conducting the current to the plate in the bottom of the furnace. The production of the calcium carbide is by the heat of the electric arc alone and not by electrolysis, the temperature of the arc being in the neighborhood of 3,500 degrees to 4,000 degrees Centrigrade, while that of the ordinary smelting furnaces ranges from 1,200 to 1,500 degrees Centrigrade.

At the end of the run the current was cut off, the furnace was allowed to cool down and the product and unused material removed and carefully weighed. During the production of the carbide some of the mixture is lost by passing up the chimney with the gases of reduction, which burn with wild sheets of flame, increasing with their hissing the already deafening roar of the immense alternating current arc. The weight of the calcium carbide actually produced in this test was 139 pounds, the unused material amounting to 607 pounds, to which must be added the water contained in the lime, 165 pounds, making the total unused material 772 pounds.

(*To be Continued.*)

PRINCIPLES OF DYNAMO DESIGN.

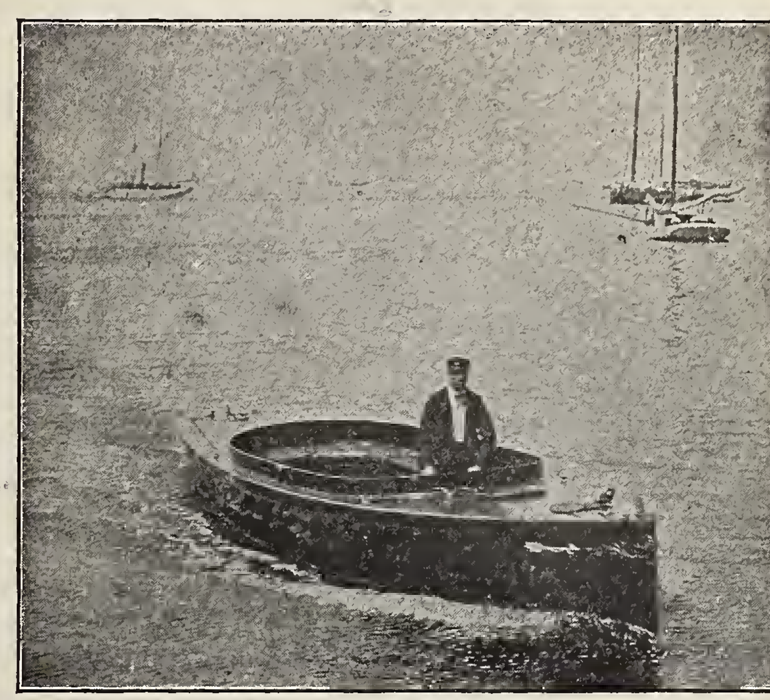
BY

Newton Harrison, E.E.

(*Continued from page* 230)

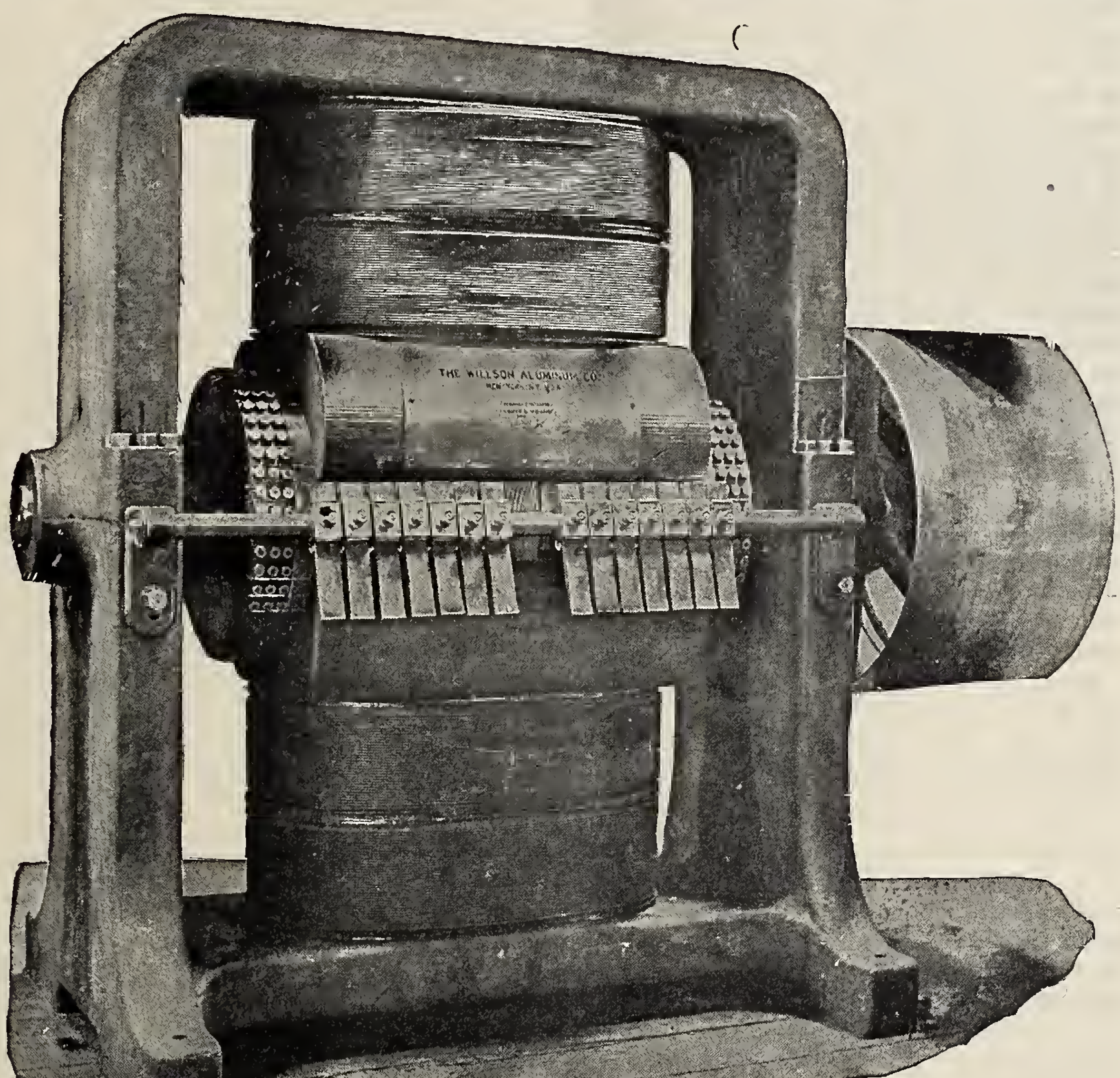
Besides the action of drills the application of motors to pumps and hoists, and their unequalled ability to provide the cleanest and most convenient source of power for yachts, have brought forward many new developments in each of these directions. The practice is common in all buildings using electric light to have an automatic pump attachment. The float, when it rises to a certain point, makes contact with a metallic piece which shuts off the motor and prevents an overflow. There are a myriad of ways in which a motor might be applied as yet unconsidered. In connection with boats or launches, the last fair at Chicago demonstrated the ease with which an electric launch is controlled. Many thousands of visitors were enabled to appreciate the surpassed elegance and convenience of these equipments from every standpoint. The practice employed in such particular lines of work, when carried on on a large scale, is the installation of a charging plant. This central source of power enables each launch to charge its storage cells without any difficulty and be ready at any instant for immediate use.

The most excellent of this description was built for the Czar of Russia. In ship use they are handy, as they may be charged while hanging in the davits. As an adjunct to a naval cruiser they have proven irreplaceable.



ELECTRIC LAUNCH.

It is not alone the motor which may be thus considered —it is other more complex applications of both in common ; at present, the use of motor transformers or rotary transformers for the reduction or change in pressure and current.

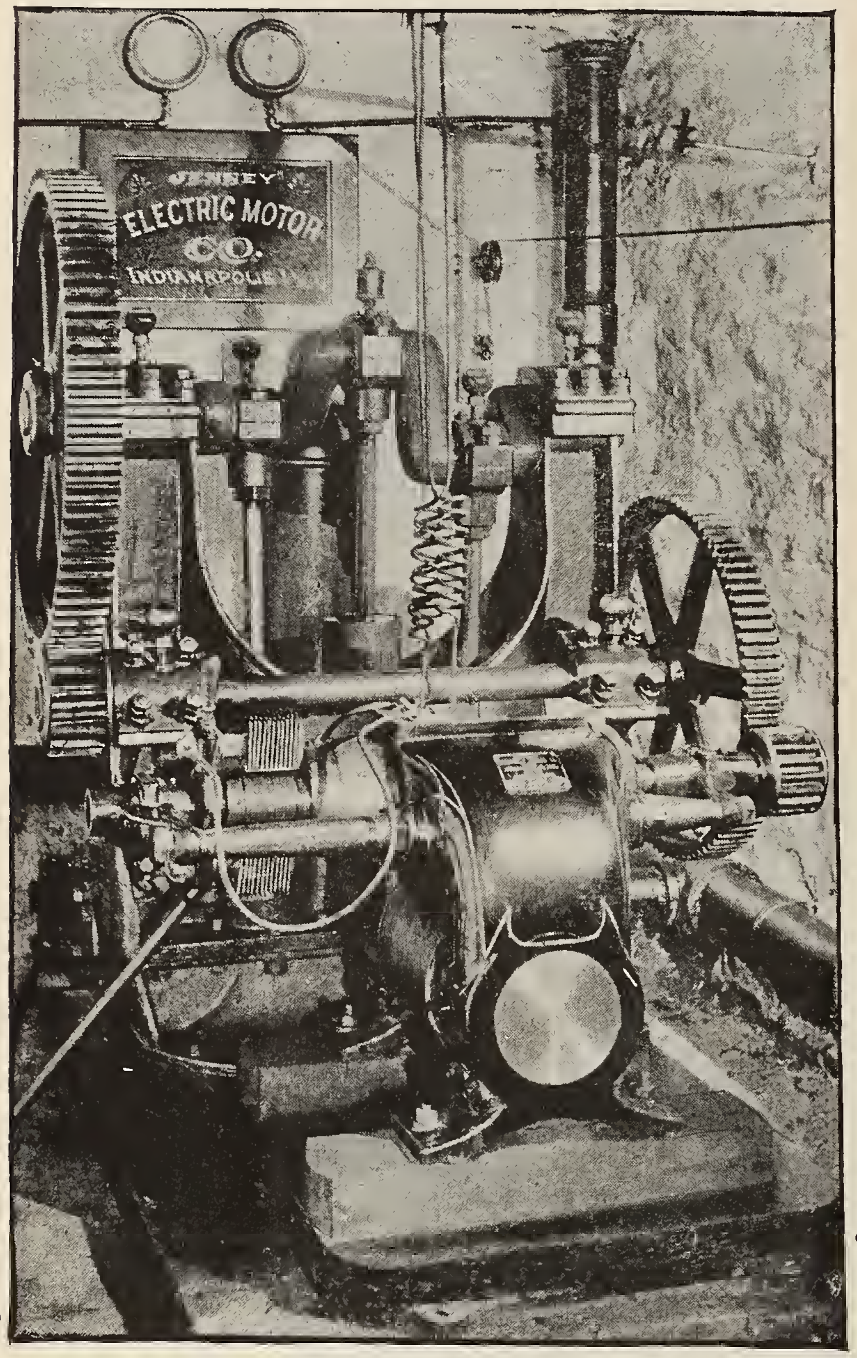


DYNAMO FOR ELECTRO-METALLURGY.

It is now possible for a man engaged in the plating business to obtain a continuous current transformer and, by using it on the ordinary mains, produce a pressure of any value within his compass of work with perfect ease.

The principle followed out in this work is that involved in the action of a transformer.

The machine is supplied with two armature windings. One receives the current at (say) 110 volts pressure and, rotates the armature; the other, connected to another commutator, produces a greater or less pressure as desired. This, of course, depends upon the number of turns, etc.; but the variation in pressure may be affected by means of the field coils; that is to say, by controlling the current passing in them. This arrangement is equivalent



ELECTRIC PUMP.

to connecting up a motor and dynamo to one shaft, and developing current and pressure as required.

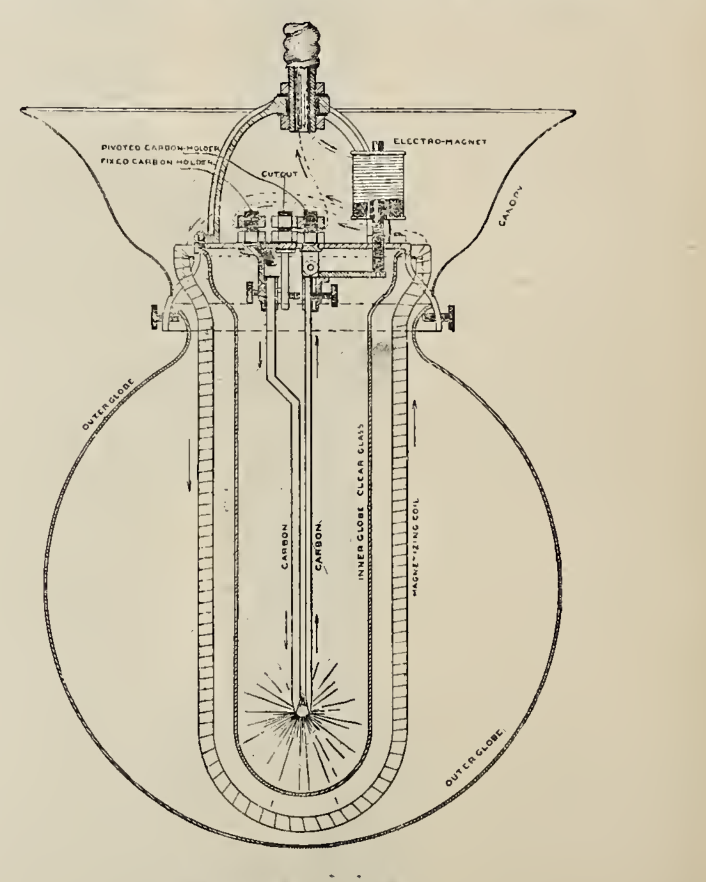
For many other purposes the motor and dynamo has been used, and the greatest lies in its application to metallurgy. Copper is refined by electrical means today, to an extent only possible in the past within the laboratory. C. E. Brown, of the Oerliken works of Switzerland, is the leading designer of electrolytic or metallurgical apparatus. This heavy machinery is in use in many large refineries. The conditions imposed upon a plating generator are such that magnitude has greater effect upon its wearing powers than anything else. These machines are massively built and are able for that reason to stand the heavy strains at times put upon them. A class of copper of great purity is now produced by electrical refineries. As much as 105,400,664 pounds are refined at an expense of $700,000. The anode is composed of black or blister copper; the solution of sulphate of copper. About 36 dynamos, aggregating 2,000 K. W., are used. The vats are placed in series very frequently, thus allowing the use of a high-pressure machine. (*To be Continued.*)

ELBIRON, N. J.—Architect J. A. Wood, 153 Broadway, New York city, has prepared plans for the erection of the Club Hotel, at a cost of $1,400,000.

THE NOWOTNY ARC LAMP.

A FEW years ago the arc lamp was tried on low tension circuits in the *Sun* Building. As an experiment it proved very successful and became the means of so multiplying the sale of arc lamps that, strange to relate, they are today one of the most successful indoor illuminants. The incandescent light has met an old and worthy competitor. This is not all, however. For many years the unprotected condition of the arc lamp, its exposure to rain and snow and unfortunate habit of occasionally dropping a spark of carbon dust made it merely a sort of substitute for something better—a convenience that was to be dropped when possible. But its future history and development was still hidden when such ideas held sway. The possibilities of arc lighting were not imaginable nor any expectation placed upon a further and valuable improvement in them. It is fortunate for us that the vitality of a good device is always noticeable. The use of arc lamps on other than high tension circuits made room for many valuable inventions. The mechanism ceased to require the touch of a policeman's club. Regulation with improved mechanical construction became an easy possibility. The additions did not cease at this point. There was still a new field to be entered. It was discovered that carbon, if prevented from oxidizing while throwing an arc, would last ten times as long.

To enclose the carbons in a closed globe with a valve attachment was a simple matter. The arc consumes the oxygen in the enclosed space and then ceases wearing away with any great rapidity. This innovation has become so popular that a lamp without it is noticeable. The

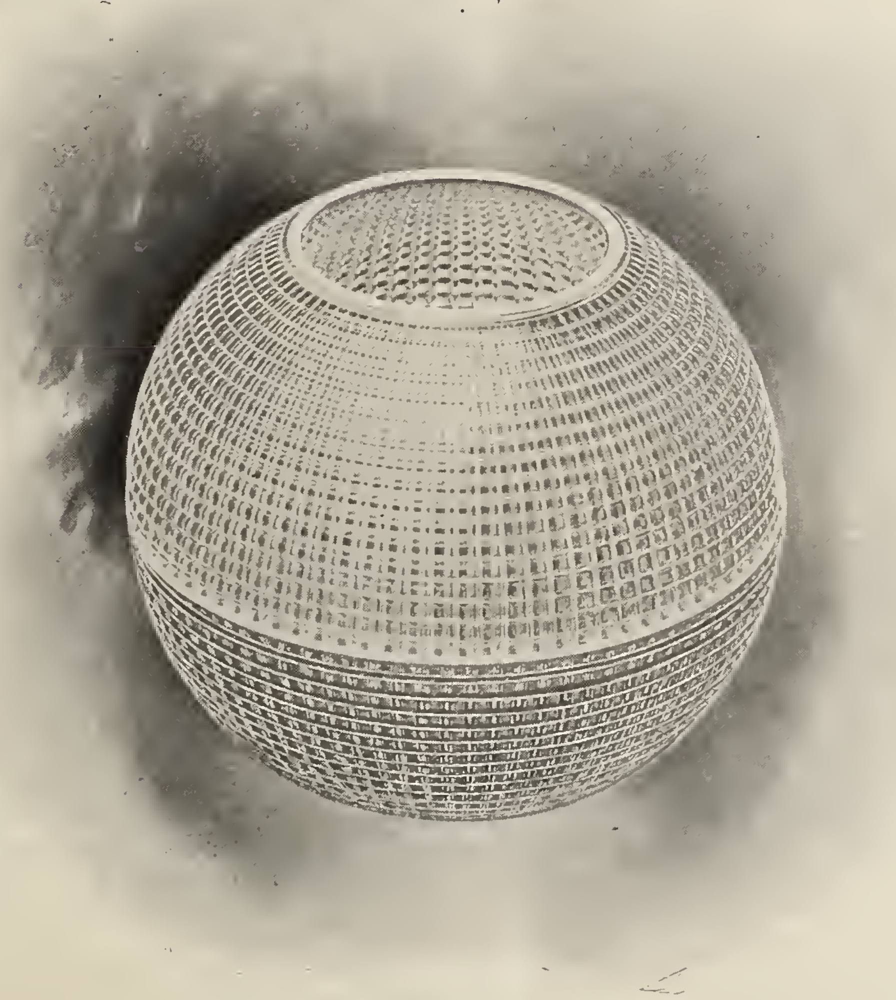


THE NOWOTNY LAMP.

Nowotny arc lamp combines many interesting points in its construction.

The claims made by its manufacturers are strikingly true. Vertical carbons burning in a closed globe give them an arc of effective lighting power. The closed globe adds long life and places it among the most improved makes. A very interesting feature of the lamp is the means taken to direct the arc down. An arc is likely to travel around the carbon tips, and in this type a shadow would inevitably result. To hold it in position it is surrounded by an outer winding whose magnetic effect keeps it in the best light-giving position. It is strange that so simple a fact had escaped the notice of all other inventors whose efforts to make this type a success failed. The readiness with which the lamp is handled and its ingenious construction place it to the front of all arc lamps at the fair.

MESSRS. C. S. Knight, manager, and J. J. Wood, electrician, of the Fort Wayne Electric Corporation, with Mr. F. H. Leonard, Jr., the inventor of the single-phase self-starting synchronous motor, built by the Fort Wayne Co., were visiting the various exhibits Monday night in company with Harry C. Adams, Jr. Mr. Wood especially enjoyed the phosphorescent diamond, a $2,000 gem held on the finger of Mr. Kunz, the trusted exhibitor for Tiffany & Co. They were much amused with seeing their bones in the Edison X ray exhibit. The Fort Wayne Co. have a fine exhibit of self-starting synchronous motors in popular sizes; also their well-known high tension arc dynamos, lamps, volt and ammeters, switches, etc.



HOLOPHANE.

HOLOPHANES.

C. ROTT, ESQ., Secretary and Treasurer.

FOR many years it has been a difficult problem to provide a shade or globe that would uniformly diffuse light. Almost all globes and shades now in use cause unsightly shadows and blurs of light that pain and injure the eyes. These difficulties are now overcome by a new invention called the "Holophane," which is sold by the Geo. A. Macbeth Co., of Pittsburgh, Pa. This invention consists of a flint glass globe, corrugated both on the inside and outside, and by these means capable of sending the rays of light in all directions with an unequalled softness. The facets of the glass act like little mirrors, reflecting the light a thousand times back and forth and then radiating it as a mild, effulgent light without the least shadow being discernible.

The invention is Parisian, representing the crystallized ideas of both Messrs. Blondel and Psaroudaki. Mr. Blondel is a consulting engineer in the French lighthouse service. The Geo. A. Macbeth Co. are getting out a complete line of these goods of all shapes and sizes, to be used either for home or public illumination. They have overcome every objection that has hitherto existed against shades, globes, etc., and are prepared to make a tests of their goods on any occasion.

GORDON NOBLE.

Mr. C. Rott, the treasurer of the company, was present at the electrical exposition and was the only one there that had his hand photographed by means of the X rays. The exhibit of the Macbeth Company at the exposition gives visitors a fine opportunity to judge of the excellence of the light proceeding from the "Holophane."

The business is ably managed and, with Mr. Macbeth to assist, they can expect every success.

In conclusion we cannot ignore the fact that the handsome booth at the exposition represents the artistic skill and labor of Mr. J. Miller. Mr. Miller is an expert electrical engineer and the positions of the various beautiful "Holophanes" show great taste on his part. His assistant Mr. Gordon Noble can be seen at the exhibit nightly, and can be identified by the illustration.

We seldom speak of our own work, although in this case, the ELECTRICAL AGE exhibit on the X ray floor, we desire to call particular attention to. You will find Kimber's new book on electric wiring specifications for incandescent lighting. You should have one of these books; it shows you how to draw specifications for all systems of electric light wiring. A good book for all is the new induction coil, or how to work the X ray with details and illustrations. We can send you any book you want on receipt of price.

N. E. L. A. AND EXPOSITION NOTES.

THE EXPOSITION BUILDING.

THERE is a great feeling of satisfaction existing about the fair. Visitors are more than satisfied and make their calls as long as possible. The telephones connected to Niagara are in constant use. The X-ray department flourishes; crowds await their opportunity to peep through the covering of flesh and see their own bones beneath. A great spirit of activity prevails. This will not be the last electrical exposition New York will have. The good impression created by the work of our friends will last; it will lead to another fair more amazing, more replete with new wonders than this. If our predictions do not fail us we will hear friendly voices from England speaking through the ocean's depth. An improved long distance sub-marine telephone system will add itself to the coming list of inventions. Maybe the roar and bustle of London streets will be voiced across the Atlantic, or Niagara's deep diapason be listened to by wondering Englishmen.

To those whose efforts have added life and substance to the fair we have a word to say.

Manager C. E. Stump and President H. J. Smith of the executive committee of the Exposition Co.; Mr. Geo. F. Porter, secretary of the N. E. L. A., and Messrs. Peck, Corey and Harrison, have devoted the closest attention to the development of the fair.

They are to be congratulated upon their able work, their self-sacrificing efforts and unqualified success.

The New York Insulated Wire Co., of 13, 15, 17 Cortlandt street, N. Y., received their guests in the Murray Hill Hotel. The representatives are gentlemen of excellent ability and of an unexcelled suavity. They are Messrs. Gallaher, Gue, Kelly, Wolff, Barker, Hoover and Brewster.

Messrs. L. Katzenstein & Co., of 357 West street, general machinists' and engineers' supply people, were ably represented by Mr. F. T. Holt. He is one of their best representatives and evinces an interest and experience which make him of great value to them.

Royce & Marean, electric light contractors, were at hand at the exposition.

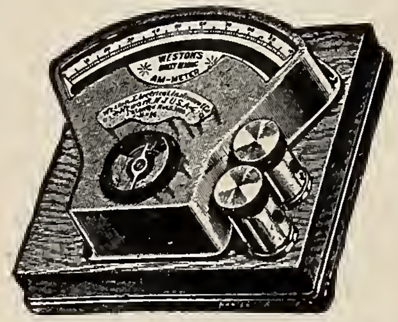
New York Safety Steam Power Co., of No. 30 Cortlandt street, have a fine exhibit at the fair—one of the Safety automatic engines running a large, handsome C. & W. dynamo, connected by one of Shultz's sable rawhide belts. Mr. Tewksbury, the Safety representative, is to be congratulated on this exhibit.

Our dear friend Mr. Thos. A. Hurley was on hand with his handsome and winning ways. He represents Holmes, Booth and Haydens, manufacturers of bare and insulated wire. New York office, No. 37 Park Place.

F. E. Kinsman has a stock of fine alternating-current fan motors, which he will dispose of at a low figure. Change of base necessitates this sale. His office is in the Manhattan Life Building, No. 66 Broadway.

J. S. Speer, the secretary of the well-known Partridge Carbon Brush Co., of Sandusky, Ohio, has been in town since Sunday. Mr. Speer is the life of the carbon brush business, having established agents in all the principal centres of North America, and every agent is a hustler. Mr. Speer has the personal qualities needed to carry on a successful business. Their motor brush carbons are so popular through his agency that we need not dwell on them. Come and see them at the exposition.

Standard Paint Co. of 81, 83 John street, N. Y., are exhibiting their usual line of P. & B compounds, tape, insulating paint and armature varnish. The unequalled general manager is F. H. De Ronde. Their exhibit shows great taste on the part of the designer.



Weston Electrical Instrument Co., 114, 116 William street, Newark, New Jersey, have made a fine showing opposite the Historical exhibit, on the main floor. They are exhibiting a full line of station and portable volt and ammeters, for direct and alternating currents.

There are many thanks to be extended to Mr. E. R. Weston for his labors in raising the standard of practical measuring instruments. The fine finish, accuracy and convenient size of all of the Weston Co.'s apparatus make them the most desirable meters in the world.

Messrs. Godfrey, Harrington & Olsen, the trio, received their friends in good old, ancient form in their parlors at the Murray Hill Hotel.

The Bryan-Marsh Co., of 136 Liberty street, New York, are deserving of much praise for the excellence of their exhibit. They have a bank of about 1,000 candelabra incandescent lamps, from which they show the next president and some famous faces. They also exhibit a large line of plain, colored, ground, ornamental and alphabetical incandescent lamps. Mr. Marsh gives his personal attention to this exhibit. He gave a lecture the other evening to a portion of the New York class of the American School of Electricity, who were visiting the exposition with their instructor, Newton Harrison, E. E.

The Diamond Electric Co. are on the X-ray floor of the exposition with a line of their meters. They will give direct readings in watt-hours of low tension currents, running any number of lamps from eight up. They have them in full operation every day. Call and see them.

Adams-Bagnall Electric Co., of Cleveland, Ohio, manufacturers A. B. arc and incandescent specialties, incandescent arc lamps, alternating arc lamps, incandescent lamps, iron hanger boards. Their arc lamps are very popular on account of the fixed position of the arc at all times. Mr. L. H. Rogers, who read the paper before the N. E. L. A. Convention, is the manager of this company and was in constant attendance at the company's handsome exhibit of their specialties. Messrs. Adams & Bagnall were about the exposition last week and spoke in high praise of the work of the exposition company.

W. J. Morrison, general agent for Ball Electric Light Co., New York, will be seen at the show nightly, taking great pride in showing how they run a 50-arc lamp dynamo from a Crocker-Wheeler motor. They show one of their 100-arc lamp dynamos; also two armatures of same. Messrs. J. S. Bell, secretary; C. E. Ball, vice-president, and P. E. Ball, electrician, are to be seen at the exhibition.

General Manager J. W. Godfrey.

THE INDIA RUBBER AND GUTTA-PERCHA INSULATING CO., of 15 Cortlandt street, New York, received their friends in a handsome exhibit at the Electrical Exposition, Messrs. Godfrey, Harrington and Olson, the trio, were well prepared as usual and gave all that called the right hand of fellowship; all were initiated into the mysteries of the valuable insulating properties of Habirshaw insulation. Red and white core is their standard, as they claim the first introduction of these popular brands. They have that valuable model of Niagara Falls Electric Power Company's bus-wire joint on exhibition.

AND the moon continues to spin like a top in the famous corner exhibit of Shultz belts. Mr. J. A. J. Shultz, the popular sable rawhide belt manufacturer, has returned to St. Louis, after a pleasant week doing the electric show. His able New York manager, Mr. A. B. Laurence, is still keeping open house at the Exposition and is receiving, with the assistance of Messrs. A. C. Laurence and C. Dunthorn, both capable and popular young men. Their sable and grooved belts on the safety and Weston engines are attracting well-merited attention.

Monarch Paint and Elmer P. Morris were both elements at the electric show last week. Mr. Morris kept the crowd busy watching him shower flames of fire upon his insulating fire-proof paint, and his phonograph did the rest.

We are in receipt of a little souvenir of the Electrical Exposition which will certainly find a permanent place on our desk. It consists of a little novelty gotten out by the enterprising Standard Underground Cable Co., and is entitled A Reminder of Ohm's Law. It is certainly an original and novel arrangement of a law that cannot be too much impressed on the minds of electrical people, and the little device is more impressive than a whole volume and must be seen to be appreciated. We understand it will be sent upon request by addressing the Standard Underground Cable Co., at New York, Pittsburgh or Chicago. They are being distributed at their exhibit in the electric show. To find their booth follow the crowd.

Partrick & Carter Co., of Philadelphia, exhibit a fine line of their popular needle annunciators and burglar alarms. They show a very complete line of general electrical supplies of all kinds. They invite all users of their goods to leave their card, so they can keep them posted in the line of supplies being used.

D. Van Nostrand & Co., the book publishers, show a complete line of electrical books.

The Electric Arc Lamp Co. of New York, Louis B. Marks, M. M. E , says his Pioneer enclosed are lamp on exhibition in their exhibit, and lighting part of the hall, is superior to any at the show.

Partridge Carbon Co. have a full display of carbon brushes on the X-ray exhibition floor. Mr. Harry M. Shaw, their New York agent, is giving attention to their exhibit and explaining how these popular brushes pick currents off of motors to the lady visitors.

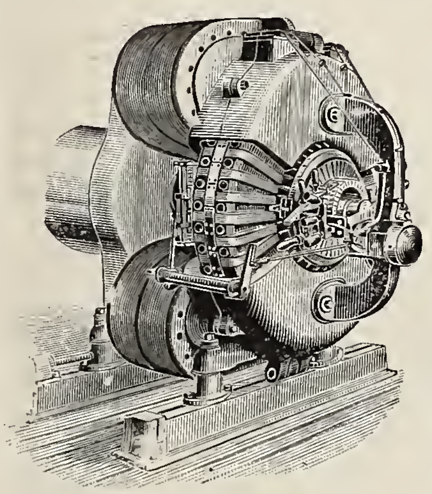
Cutter Electric Mfg. Co., of Philadelphia, have a large exhibit of their specialties in flush switches, automatic arc light cut-outs and incandescent goods to meet the wants of all electrical contractors, architects, etc.

The enclosed arc lamps are attracting unusual attention at the electric show. The Manhattan General Construction Co., 44 Broad street, N. Y., make these enclosed arc lamps. They seem to be all the rage in Brooklyn and on the Bridge, and for general commercial use, long life, less work, and better light they cannot be excelled by any other.

"SHIP" CARBONS.

The Standard Paint Co., 81–83 John street, city, has just received a large shipment of the celebrated "Ship" carbons, manufactured by Shiff, Jordan & Co., Vienna. They are now prepared to supply orders for these carbons in any quantities. A full line of these carbons is now on exhibition at the Electrical Exposition under the personal supervision of Mr. John Jordan, general manager Shiff, Jordan & Co., Vienna.

Frederick Pearce, 79 John street, city, manufacturing electrician and dealer in general electrical supplies, is now sending out a handsome catalogue, containing valuable pointers on electric fans for the season of 1896.



The Excelsior Electric Co., of 115 Broadway, City, have a fine exhibit of their arc and incandescent dynamos and motors. Mr. Fuller, the president, and Mr. Churchward, the electrician of the company, are daily receiving congratulations upon their fine showing at the Exposition. Besides their regular line of dynamos and motors they are exhibiting small arc dynamos and motors, their new motor generators, arc lamps, switches, cut-outs, etc.

The New York Carbon Works have a fine exhibit at the Electrical Exposition, showing over 150 different styles of battery carbons; also retort carbons. They have lately bought the patents of Emile Berliner covering the process of making carbons porous, patented in 1886. There is a large demand for these porous carbons amongst battery users and the company is kept busy supplying the demand for the same. The exhibit is in charge of Mr. G. W. Mills, who will make his home at the exposition during the month of May. He is always on deck with his usual broad smile.

An interesting exhibit to visit at the Exposition is that of the Boynton Multi-volt Battery Co., in charge of Mr. Chas. H. Brigham. The current for the five 8-inch fan motors is generated by one cell of the "Multi-volt" battery. The great advantage of this battery over others lies in the fact that there are three elements to each cell of battery. These three elements can be used separately or together. Each element will generate two volts, and the three elements together are equal to five volts. They are always ready for use, as the three elements can be raised or lowered into the solution separately or together.

The Tucker Electric Construction Co., of New York, have a fine booth fitted out with their auto-telephone system. They have half a dozen 'phones connecting different points in the building, so that any one can talk to and from their booth. They also have a number of views of fine buildings in New York, that they have equipped with electric light plants, wiring, etc.

INQUIRY COLUMN.

In this column we shall endeavor to answer all questions relating to the science of electricity that may arise in the minds of our subscribers.

(*Q.*)—Lines of Force.

WACO, TEX., April 6, 1896.

THE ELECTRICAL AGE.

Dear Editor:—Can you tell me whether the line of force used in building dynamos is the same as that seen by sprinkling filings on a horseshoe magnet also called by the same name?

HENRY NEILSON.

(*A.*)—The expression line of force means a certain amount of magnetic energy, which in the case of an electromagnet can be accurately estimated by taking into consideration the length, cross-section, quality of the iron, the number of ampere turns, etc.

The so-called line of force issuing from a steel magnet illustrates the physical tendencies of any other line of force; the filings show the presence of a directive force which gathers the filings together in peculiar lines or streams which, while illustrating the direction, do not indicate the strength and serve merely as a visible proof of their existence.

NEW YORK, N. Y.

Dear Sirs:—I address your worthy publication in the hope of receiving some light on a matter of worriment to myself and family. Our house is equipped with burglar alarms and electric bells, yet at times the most peculiar things happen. Our bell will ring spasmodically sometimes early in the morning; the electrician says there is no difficulty, yet there is evidently something the matter. During the storm last week that bell gave us all the chills. Surely ghosts don't wander around in such weather.

Yours truly,
C. WILCOX.

Ans.—We do not think your house is entirely doomed. Try to notice whether the bell or bells ring when there is a storm, especially a wind. If such is the case you are safe. There is a loose, let us say, *rattling bad connection* somewhere, probably in the push-button. You may be unfortunate in having push-buttons with brass shells; such a case has come under our notice lately. The wind may make the house vibrate slightly and jar the loose end. Look into it and hope for the best.

A TENNESSEE CENTENNIAL.

INAUGURAL CEREMONIES JUNE 1, 1896. OPENS MAY 1, 1897, AND CONTINUES SIX MONTHS.

NASHVILLE, TENN., April 1, 1896.

Sir: We are honored in having the pleasure of calling to your attention and consideration the celebration by the people of Tennessee of the one hundredth anniversary of the State's entry into the Union, and to extend to you, and to your official as well as personal staff, a cordial invitation to be present at the ceremonies to be held on the natal day, June 1, 1896, at the Capitol of the State, under the auspices of the Tennessee Centennial Exposition.

Very respectfully yours,
J. W. THOMAS, President.
E. C. LEWIS, Director General.

Telephone Notes.

LODA, ILL.—The Loda Light, Water and Telephone Co. has been incorporated, to operate an electric light plant, etc. Capital, $10,000. Incorporators, E. S. Slocum, J. S. Sheldon, W. L. Kinsman, N. P. Goodell, John T. West and others.

MILWAUKEE, WIS.——The Wisconsin Telephone Company has decided to add to its metallic circuit the lines between Milwaukee and Oshkosh, Milwaukee and Appleton, and Kaukauna and Green Bay. The metallic circuit lines in the southern part of the State will be extended between Whitewater, Watertown, Lake Geneva, Waupun, Mayville and Theresa.

WILLIAMSPORT, MD.—The system of the Chesapeake & Potomac Telephone Company, in Western Maryland, will shortly be extended to connect Martinsburg, W. Va., with Cumberland. The route for the new line runs through Williamsport to Clear Spring, and Hancock to Cumberland.

FOR UPTOWN TELEPHONE SUBSCRIBERS.

An uptown branch of the Contract Department of the Metropolitan Telephone and Telegraph Company has been established at 113 West 38th street (one door from Broadway), where all business relating to the supply of telephone service can be transacted as readily as at the main office at 18 Cortlandt street. There are 14,500 telephone stations in New York City. Metallic Circuit Service, Rapid, Efficient, Permanent, can be had from $75 a year.

TELEPHONE PATENTS, MAY 5, 1896.

559,366. Switchboard for Telephone-Exchanges. Joseph P. Davis, New York, N. Y., assignor to the American Bell Telephone Company, Boston, Mass. Filed Aug. 10, 1895.

559,367. Switching Apparatus for Telephone-Exchanges. Joseph P. Davis, New York, N. Y., assignor to the American Bell Telephone Company, Boston, Mass. Filed Aug. 10, 1895.

559,409. Telephone-Circuit for Police-Boxes. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed Jan. 26, 1894.

559,410. Apparatus and Circuit for Telephones. Charles E. Scribner, Chicago, and Frank R. McBerty, Downer's Grove, Ill., assignors to the Western Electric Company, Chicago, Ill. Filed Jan. 8, 1895.

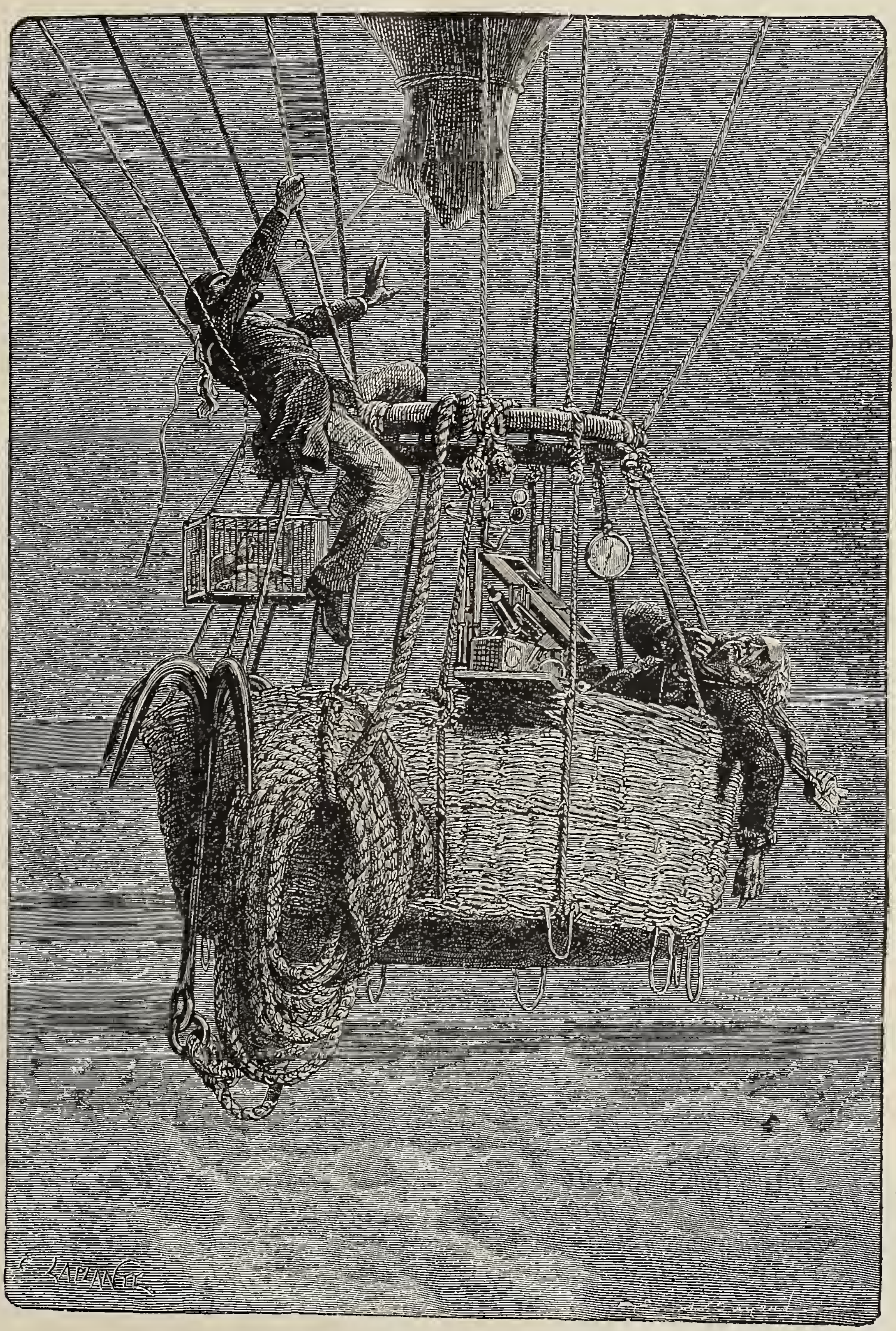
559,411. Apparatus for Telephone Switchboards. Charles E. Scribner, Chicago, and Frank R. McBerty, Downer's Grove, Ill., assignors to the Western Electric Company, Chicago, Ill. Filed Feb. 28, 1895.

559,476. Telephone-Transmitter. Louis D. Appleman, Waynesborough, Va. Filed May 25, 1895.

559,616. System of Current Supply for Telephones. Charles. E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed Jan. 8, 1895.

The Electrical Age.

Vol. XVII., No. 21. NEW YORK, MAY 23, 1896. Whole No. 471



SEVEN MILES ABOVE THE EARTH.

ELECTRO-AEROSTATICS.

Many attempts have been made in the past to navigate the air. All sorts of devices have been used to overcome gravitation and utilize the buoyancy of the atmosphere. Since Montgolfier's time the art has been carried on in a crude and unscientific manner. The past few years, however, have seen a change. Thoughtful men have taken hold of the subject and are now attempting to solve the problem.

It has been divided up into two general branches by those trying to obtain results.

(I) Locomotion through the air by means of a propelling device.

(II) Man flight.

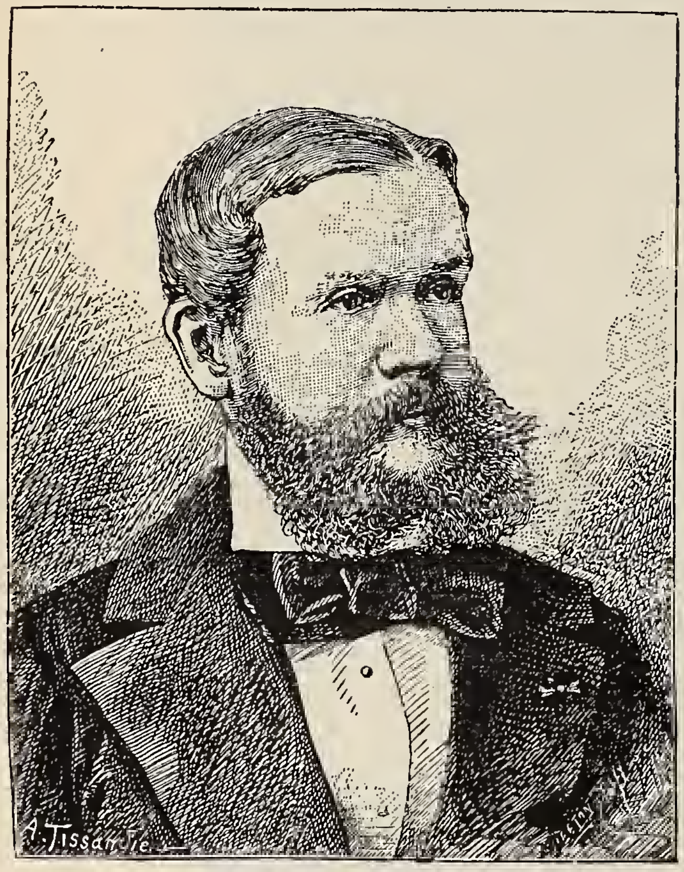
The first interests us because it is very likely that the motive power applied to such aerial vessels as will ultimately succeed will be electricity. Hot air, hydrogen and illuminating gas have been tried. Many notable ascents have been made attended at times with hairbreadth escapes.

Others have been surrounded by the deep gloom of tragedy and the unfortunate participators repose beneath the sod. There is undoubtedly an element of great danger attached to all experiments of this description ; yet the object in view is so worthy that the lives sacrificed were voluntary if not enthusiastic offerings. To attack the subject coldly would be somewhat difficult in the light of past efforts.

Many engineers in France, Germany, England and America are deeply interested in the problem and have spent much time in looking for some practical issue as a basis for regular and systematic work.

Hiram S. Maxim, Gaston Tissandier, Renard and Krebs and Prof. Langley are names made notable by the labors of their owners.

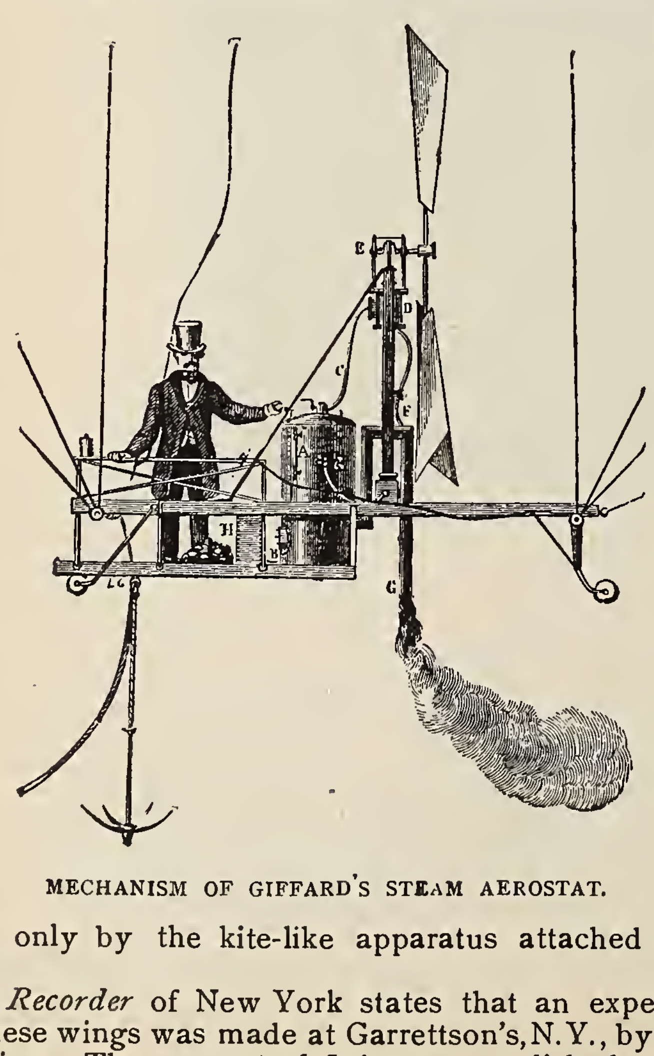
It is also remarkable that the old legend of Icarus has



GASTON TISSANDIER.

not been forgotten. Wings are as greatly desired today as in the old Grecian times, when it was thought God-like to wear them.

Herr Lilienthal has invented an outfit which enables a man to plunge with impunity from great heights, sus-

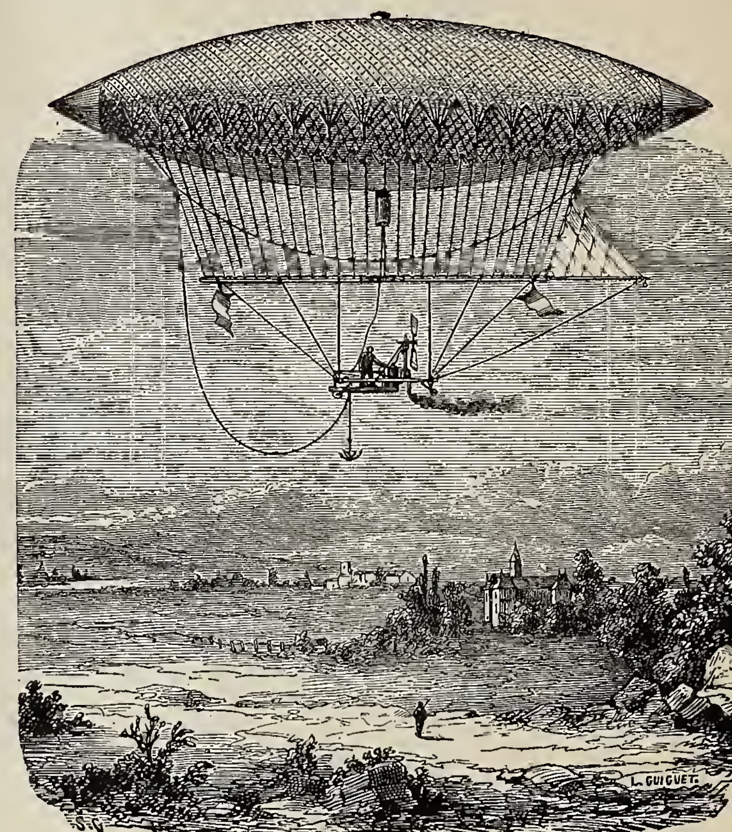


MECHANISM OF GIFFARD'S STEAM AEROSTAT.

tained only by the kite-like apparatus attached to his body.

The *Recorder* of New York states that an experiment with these wings was made at Garrettson's, N.Y., by Harry B. Bodine. The amount of flying accomplished was not very great, but that which was done at least illustrated the fact that when a certain amount of skill has been obtained flights covering a distance of 300 yards will lie within the compass of anyone. The knack of controlling the wings and making use of the wind, by whose means flight and ascent is sustained, will ultimately be gained by practice.

The principle of having a current of air strike an inclined



COMPLETED AEROSTAT.

plane and make it exert a rising tendency is followed out in this device.

Conversely speaking an inclined plane passing swiftly through the air will exert a similar tendency to rise. This is the basis upon which many hope to succeed. It is reasonable and covers at least the groundwork to be followed out.

Leonardi Da Vinci, living at a time which corresponded with the discoveries of Columbus, was one of the earliest workers in this field of invention. He was born in 1452 and developed in early life the strongest inclination for mechanical studies. The subject of aerostatics occupied his attention, and he followed out his researches in this direction by investigating the flight of birds. (Treatise upon the Flight of Birds.) This was one of the earliest attempts made to follow a line of investigation which was consistently carried out.

The result of Leonardo Da Vinci's work and that of Lilienthal's is separated by a gap of 400 years. Yet the conclusions of both are alike. *The extreme difficulty of keeping the centre of gravity in the right place* was understood by Da Vinci as the worst impediment to progress. It is still the greatest source of trouble to Lilienthal.

Leaving the subject of man-flight, a more interesting department opens up to our view—the development of aerial vessels self-propelling and independently steered.

Dirigible balloons were at one time thought to be an impossibility. It is not at all necessary to experience difficulty from a balloon driven through the air. The similarity existing between a submarine vessel and a self-controlling aerostat is quickly evident.

Both are immersed entirely in the medium and both are governed in general by the same laws.

Experiments made by Wenham, cited in a paper read before the Aeronautical Society of Great Britain in 1866, gave some very valuable results.

"A weight of 150 lbs. suspended from a surface of the same number of square feet, the uniform descent will be 1,300 feet per minute, and the force given out and expended on the air, at this rate of fall, will be nearly six horse-power; and conversely, this same speed and power must be communicated to the surface to keep the weight sustained at a fixed "altitude." His calculations imply that about 3 H.-P. is required to raise a body weighing 100 lbs. from the ground by means of a screw.

Benjamin Franklin showed quite a deep interest in Aeronautical work and corresponded with several of his friends on the subject.

James Glaisher, F. R. S., made some interesting balloon ascents, one of which carried him seven miles up. The illustration shows Mr. Glaisher lying back insensible and his companion, Mr. Coxwell, whose limbs have become rigid endeavoring to grasp the valve-cord with his teeth. The courage and intrepidity required for such voyages can be faintly imagined. Glaisher's observations were singularly clear and display a mind of unwonted vigor.

Aerostats may be divided into two classes:

(1) Vessels rising by their own buoyancy.
(2) " lifted by means of screws.

Gifford built an aerostat which practically answered to the description of a balloon driven, however, by a small steam-engine and steered without any difficulty.

Gaston Tissandier followed the same line of work applied electricity for the same purpose.

He used a light motor, and after trying many types of cells selected the bichromate as the best.

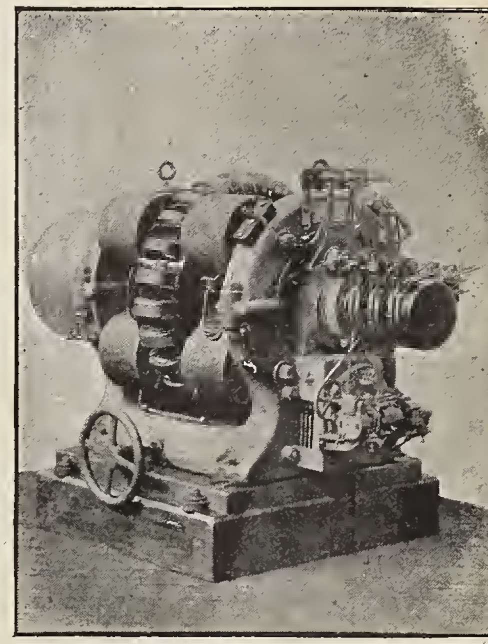
It does not seem at present as though the apparatus could be built of light enough weight to do the work expected of it.

If by means of rotating screws 1 H.-P. is required per hundred lbs., there is still the weight of the power to be considered. Maxim experimented with a heavy machine weighing several thousands of pounds. It possessed no buoyant power of its own, depending entirely upon inclined planes rapidly rotated for its ascensive force; steam was the power applied. The results clearly showed that present means were applicable with success. The danger and lack of substantial facts has not carried the work much further. Before leaving a subject so full of future benefits, it is necessary to state that the aerostat of coming years will be heavier than air.

Its functions will be somewhat varied; to make headway against the wind and to lift itself from the ground are but two of them. It must be capable of retaining a fixed position in the atmosphere and have a means of descending without dangerous rapidity should the ascensive force fail.

The application of electricity to aeronautical vessels is certain.

The entire question hangs upon a light and concentrated source of power. The machine will be built to move through the air in accordance with the best engineering principles and carry passengers from point to point with perfect safety.



The Brush Electric Company have one of the most brilliant corners of the fair. They display their enterprising and progressive spirit. The multi-circuit arc machine is an invention of so decided a character that with it alone a crowd of electricians could be drawn together. The Brush Co. have made quite a success of their exhibit. Sunlight is the only rival they will recognize in their booth. Colonel Rogers has taken care of the Brush company's interest at the fair. He has made the whole thing sparkle from beginning to end. He shows his soldier-like spirit in the way in which he handles difficulties. The company have found in him a man of wide and thorough experience. The Electrical Accumulator Co. and the Municipal Electric Lighting Co. testify to his exceptional ability in their inception and development.

BRUSH ELECTRIC CO.'S EXHIBIT.

The cut shows a large bank of arc lights, at least 100, burning together on the multi-circuit dynamo.

They attract a great deal of attention; the light thrown down being equal to about 200,000 candle-power. If the science of arc lighting grows to its greatest, the top of the heap will be occupied by the Brush Co.

The utility of the multi-circuit machine is understood by all. The aid the colonel has received came from J. R. Prentiss and H. T. Douds. They are as enterprising and able a pair as can be found. The company always selects the best men it can find to manage its affairs and attend to its engineering departments.

EQUALIZER SYSTEMS OF DISTRIBUTION.

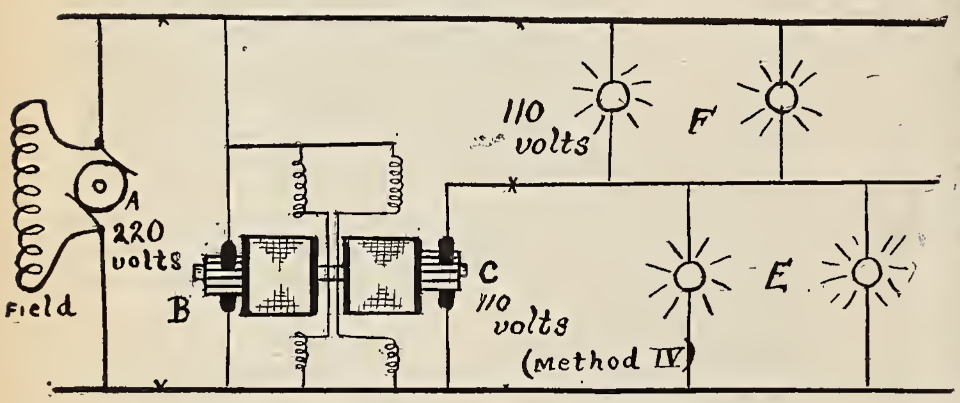
BY A. CHURCHWARD.

(*Continued from page* 246.)

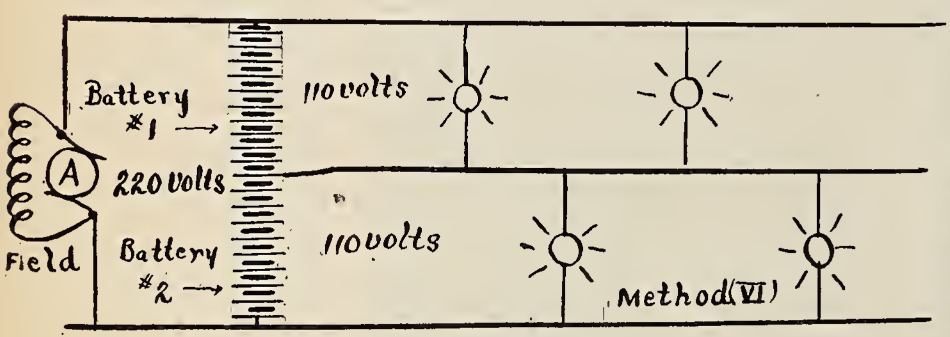
SINGLE dynamo 220 volts, A, and a small machine of 110 volts, C, driven by a motor, B, connected across the 220-volt mains.

The motor, B, drives the machine, C, so that the pressure across E and F are equal; should the load be increased on E the pressure will fall and the machine, C, will supply the extra current needed to balance the pressure; if the load on E is less than on F, then C will run as a motor, driving B as a dynamo.

In this case there will be a slight unbalance of pressure due to armature reaction, etc.



Still another method has been proposed. This employs a single dynamo of 220 volts. To the brushes of this machine are connected the two outside wires; the neutral wire is connected to the centre of the armature coils, and this raises a potential midway between the two outside wires.



A system in use in central stations in Europe might be mentioned here, but we can hardly call it an equalizer system. It consists of a 229-volt dynamo and two sets of batteries. The accumulators here play the same part as their namesakes do in a system of hydraulic supply.

The battery connected to the circuit that requires most current discharges into the circuit, and thus helps the dynamo; and the battery in which the demand is smaller is charged by the surplus current.

There is no economy in an installation by this method over others, the accumulation costing much more than a rotary equalizer.

We gain this much, however—during the hours of light load the batteries may supply all the current required, permitting the shutting down of the central station during those hours.

I intend now to bring to your notice an equalizer that has passed the experimental stage and has been in operation day and night for two and one-half years; no lamps have ever been lost owing to lack of balance of the system.

Again, we only require one generator, A, 220 volts, and one small machine with two commutators, B.

(*To be Continued.*)

SINGLE-PHASE SELF-STARTING SYNCHRONOUS MOTORS.

BY F. H. LEONARD, JR.

(*Continued from page 249.*)

IN starting, the switch handle is depressed so that the lead wires which conduct the alternating current from the transformers are connected through the switch-blades to the contacts, which lead the current first to one of the commutator brushes, thence through the distributed armature windings and out through the opposite brushes to a coarse wire winding on the field-poles and back again to the switch contacts and binding-posts; these connections being identical with those of a direct-current series motor. As soon as the current is turned on, the motor commences to rotate at a constantly accelerating speed until synchronism is reached, which is indicated by the lighting of a lamp located on the switch at a dull red. This is the signal for the reversal of the double throw-switch, which then changes the complexion so that the leads from the transformer are cut off from the commutator and connected to the collector rings and concentrated armature windings, while at the same instant the commutator brushes are connected to the shunt field windings, magnetizing the field with direct current; the only office of the commutator after the motor is started and up to speed being to supply the small direct-current necessary to magnetize the field.

In starting without load, the motors will run up to synchronous speed in from five to fifteen seconds, depending upon size, windings, etc., and when load in from fifteen to thirty seconds, taking about the same current in either case, the time factor making the difference in the power consumed; the current taken under these conditions amounting to from 25 to 50 per cent. in excess of what the motor will require when running in synchronism. Bur when only required to start itself on light counter-shafting, this current may be greatly reduced by special windings.

The direct-current winding delivers a perfectly smooth current, and is not at all pulsating in character. In circuit with the field-winding is a rheostat to control the extent of field excitation. This rheostat is located in a recess in the base of the motor, the handle for its regulation being accessible through the oval opening at the commutator end pedestal. The motor, starting switch and field rheostat are in one piece, making a most simple and compact combination. All that is necessary to install the motor is to connect the secondary wiring of the transformer to the two binding-posts on the motor, and it is ready for operation.

The general design of the machine is substantial and symmetrical, with graceful curves sweeping from point to point, giving the motor a very pleasing appearance. Nothing has been spared in the design and construction of these motors to make them as perfect as possible, and the motors are evolved from a careful consideration of the two years' practical operation of a synchronous motor, after which a thorough course ef experiment was instituted and carefully tabulated to determine beyond a doubt the accuracy of the calculations for the new design. Careful attention has been given to every detail that would tend to make the motor neat in appearance and simple, so that the man without previous training, into whose hands a motor usually falls, would have no difficulty in its use.

The mechanical perfection of any piece of machinery is the all important one, and in this motor has been given the full attention it deserves. The best engineering practice of the day has been followed, and where any departure has been made it has been to make the construction more rigid and capable of resisting overload and excessive strain.

(*To be Continued.*)

THE EVOLUTION OF THE ARC LAMP.

L. H. ROGERS.

(*Continued from Page 250.*)

ATTACHING a wire of quite small cross-section to the main wire, he wound it on the same spools, but in an opposite direction to that of the coarser wire. This fine wire, after leaving the spools, passed directly to the negative terminal, making what was termed a "shunt" around the arc. The effect of this unique arrangement was the same as a controller on an engine. The more current passing through the fine wire the weaker the magnet became, and the all-important point gained that each and every lamp was a law unto itself, establishing and regulating the arc, and feeding without influencing any other lamp on the circuit.

The device termed "differential winding," or "feed," was entitled successful, and to Chas. F. Brush belongs the credit of first giving to the world commercial arc lighting. He accompanied this invention with one not much less in importance.

He invented a cut-out, a device for cutting out any given lamp, provided any trouble should happen to that lamp, so that it could not burn. This cut-out insured the absolute maintenance of the main circuit, no matter what might happen to any single lamp.

Visitors to the World's Fair in 1893 will not soon forget the impressive exhibit made by Krupp, of Germany, the gun maker of the world. Here at one side was shown a piece of iron 8 inches thick, and there by its side a gun invented for the special purpose of piercing that piece of iron with a projectile. At the next step was seen a thicker or tougher piece of metal with a more powerful gun to pierce it. And thus the race between gun and metal was maintained, until a weapon 35 feet long, mounted upon a carriage which was revolved, lowered and elevated by special machinery was exhibited, of such power that it could throw a 2,200 pound ball two miles, and at that distance pierce the toughest wrought iron plate 36 inches thick.

In a somewhat similar manner a race has been in progress between the device for generating the electric current and the device for transforming said current into light—the dynamo and the lamp. Volta invents a battery and Davy matches it with his lamp—a light formed between two pieces of charcoal. After 30 years, Faraday discovers an entirely new method of producing the electric current, and scores of inventors immediately proceed to improve the lamp to meet the new conditions. For 40 years after this time, improvements in the dynamo and lamp proceed by easy stages, hand in hand, until the invention of the differential winding, which placed the lamp far in advance of the dynamo. Immediately this winding was perfected, then began the rapid improvement of the dynamo to meet, if possible, the new and improved conditions brought about by its use. For the past 20 years and more this improvement of the dynamo has been in progress, until today machines highly efficient, close in regulation, and producing current for 125–2,000 c. p., arc lamps are as common as the poorly constructed, inefficient 16-light dynamos were 20 years ago.

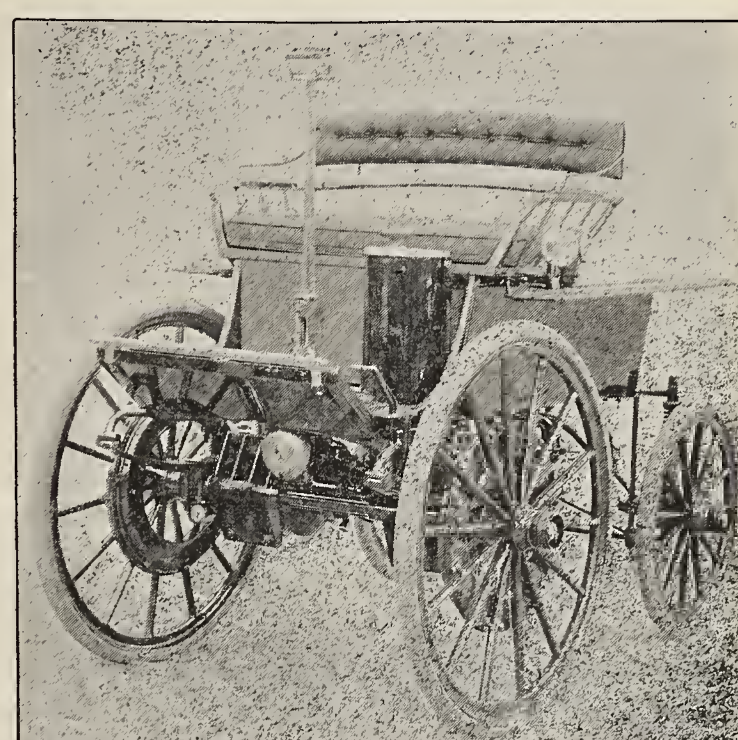
These large machine are wonders in their class. It is possible to throw all of the lamps in or out of the circuit at once, break the main line, or in fact, do anything to break down the machines electrically, and they continue to run, automatically taking care of their load, and without the least hitch of any kind. The efficiency of these machines is, in some cases, as high as 90 per cent. In short, perfection has about been reached in the arc dynamo.

On the other hand the arc lamp, as it stands today, is a poor affair compared to what it might be. It is far behind the arc dynamo as regards electrical mechanical perfection. What was considered good enough, or even perfect, 20 years ago, will not answer today. New uses have arisen for the electric light, and its adoption as an illuminant has exceeded any prophesies ever made for it. The dynamo has again more than out-reached the lamp, and the time for a new lamp has arrived.

(*To be Continued*).

The Electrical Drying of Fruit.—There would appear to be a good opening for the use of electric heating in connection with the fruit trade. It is well known that freshly gathered fruit must be dried before being packed. This process, although an apparently simple one, necessitates great care and the temperature must be well regulated, otherwise there is danger of the fruit being damaged. Large drying-rooms are in use in some cases, heated by means of steam, and although this system may be cheap to work on a large scale, it is not always so satisfactory on a small one. Fuel, moreover, is often expensive, and water-power, in parts where the fruit trade flourishes, is usually abundant. In such situations electric heating could be used with advantage. The perfect regulation allows of any temperature being obtained and, what is of great consequence in such an installation, practically no attention is required. The electrical plant, too, could be used for lighting, and a few motors to aid the packing could easily be laid down. Uses such as this offer a fine field for development, and the gain made by bringing in cargoes of sound fruit would more than cover the cost of running the necessary machinery.—*Electricity.*

The Electric Carriage and Wagon Co. was organized during May under the laws of the State of New York. Mr. P. G. Salom and Mr. H. G. Morris, of The Electric Storage Co. of Philadelphia, were at the electric show Monday night. They were making arrangements to take away the electric carriage which has been a prominent feature of Electric Storage Co.'s exhibit. They report a big demand for these carriages and need this one as a model for



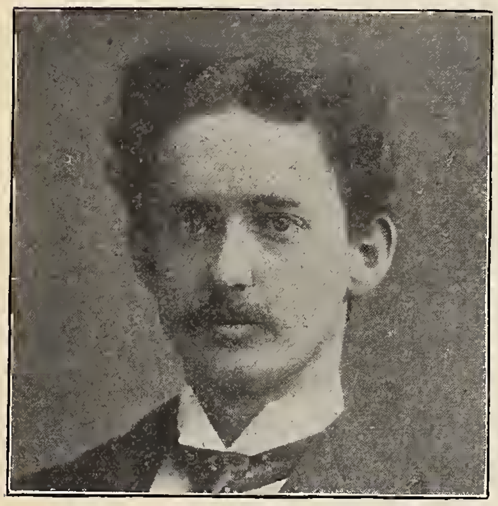
exhibition. It is the first electric carriage built in the States and won the prize in Chicago last year. Mr. Isaac L. Rice, a millionaire of New York, is the president of the Electric Carriage and Wagon Co.; Mr. W. W. Gibbs, of Philadelphia, the vice-president, and Mr. H. G. Morris, the constructing electrical engineer. This carriage is operated by one of the Lundell motors connected by a sprocket chain to the axle of the back wheels. The power is obtained from storage batteries under the seats of the carriage. The whole is complete in every detail, comprising one of the most interesting novelties at the fair. The growing demand for horseless vehicles shows the increasing popularity that they possess.

RECENT DEVELOPMENTS IN VACUUM TUBE LIGHTING.

A paper presented at the 105th Meeting of the American Institute of Electrical Engineers, New York, April 22nd, 1896.

BY D. MCFARLAN MOORE.

(*Continued from Page* 254.)



D. MCFARLAN MOORE.

I HAVE constructed several dozen distinct varieties or amplifications of the ordinary type of vibrator, such as multiple contacts, etc.

Fig. 29 shows one form, in which the object was to produce a larger number of breaks of the current per unit of time by providing two contacts, as shown. In some respects this scheme worked well, that is, the light was stronger than that produced by an ordinary vibrator with a single magnet, but the light was not steady, and when the connections were changed so that but one magnet was used, the light flickered still more. All the vibrators, so far considered, have had their springs so adjusted that the contacts remained normally closed. Fig. 30 shows a circuit using a vibrator normally open. The small magnet constantly closes the circuit, and the large one opens it. This arrangement gave a good light. A number of ordinary vibrators have been operated, arranged with the magnet above the armature, so that gravity helps close the circuit. Of course, springs and armatures of scores of shapes and sizes, including gravity vibrators, have been tried, the principal object being to obtain a method for taking up the wear of the contact points; but the best solution of this problem lay in getting contact points that would not wear because of a more perfect vacuum.

Turning now from the mechanical construction of vacuum vibrators to consideration of their unique properties from a scientific standpoint. As stated before, roughly speaking the prime object of making the break of the current in a vacuum is to produce an increased C. E. M. F. over that resulting from an air-break. But I venture to say, few as yet realize the possibilities and the tremendous advantages involved in the separation of electrodes in high vacua at regular periods of time. It is indeed questionable whether the increased C. E. M. F. of the ether gap is responsible for the results. It is more probably due to the fact that the wave lengths of the current resulting from an ether gap differ radically from any that have heretofore been known of. Recognition of the importance of this phenomenon led me to use the word "etheric" in connection with my system of tube lighting, because the light is directly dependent upon what I designate as the ether gap of the vacuum. Our best notion of the separate existence of the ether is formed by thinking of that which remains within a vacuum of the highest degree we can produce. It may have been noticed that, so far, I have not used the word "phosphorescent." It is undoubtedly a misnomer as applied to tube lighting; but to make matters worse, there seems to be no word in existence exactly or even approximately suitable.

The word etheric is especially applicable to light produced by the ether gap. That incomparably better results should be obtained by using a vacuum as a dielectric seems to be in perfect accord with accepted theory, which has largely been upheld by actual experimentation. For example, setting aside for the time being that part taken by the magnet, let us consider only the break—the spark.

First, what is required is a continuance of the rapid oscillations of an electric discharge, and I desire to show that this is accomplished by a vacuum vibrator in an ideal manner. One method of obtaining an oscillating discharge is to use a potential such that an air-gap of considerable width is bridged by the spark. But the manner in which such discharges succeed each other largely depends upon the irregular movement of the air within the gap.

This method is unsatisfactory for many other reasons, among them the very objectionable high tension required, but there remains the conductive method of causing a spark, exemplified in the ordinary vibrator and induction coil. Here the sparks in the primary circuit can be made to succeed each other quite rapidly, but the length of time required for each complete break is long. However, with the vacuum vibrator, a new and simple device, the conditions are different, and so are the results. Here the dielectric is an exceedingly thin film of ether, which is capable of withstanding a great electrostatic strain, but when it does break down it does so very suddenly; that is, it may be considered a *perfectly* disruptive discharge, and therefore its single oscillations are very short; but as a whole they are long continued. This means that the frequency is high, and, according to Maxwell, very high-frequency oscillations are probably identical with light.

The small magnet, being a circuit of induction, has its own natural period. But its period and moment of inertia will be less, the less its capacity; that is, the smaller the magnet the smaller the period, or the higher its frequency can be.

But to have an intense light, there is required a high E. M. F. of self-induction. This the small magnet furnishes, because what is lost in self-induction by using a compar-

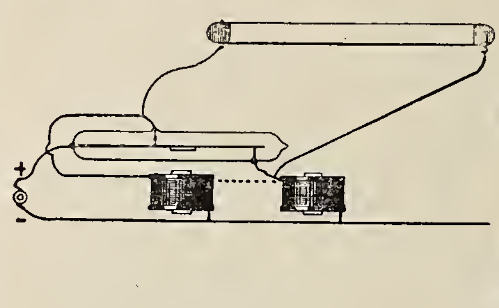


Fig. 29.

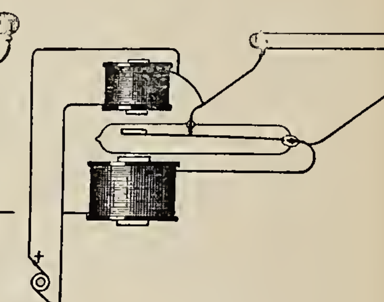


Fig. 30.

atively few turns of wire is more than made up by the suddenness of the discontinuance of current flow, and the fact that the high vacuum precludes the possiblility of loss to the self-induction ordinarily due to the glow discharge which precedes the disruptive discharge in the air. The self-induction also depends on the *amount* of current flowing through a circuit when interrupted, and this the vibrator provides for, in that *all* the current which flows through the coil does not pass through an arc, but is transmitted over actual metal contacts. Also since these contacts are so very close, due to the thinness of the dielectric, the oscillatory discharges do not leave the metal and pass in objectionable minute streams through the vacuum. And the number of oscillations in the coil, and the amount of light, depend in a measure on energy expended to overcome the resistance of the dielectric, which is almost infinitely greater than that of air.

That the silent discharge prevents long continuance of oscillation is shown in the Hertz experiments, where the experiment fails unless the balls of the electrodes are kept polished. That the vacuum vibrator is nearly ideal is again shown in that these troubles are almost entirely eliminated. The ether is undoubtedly the ideal medium in which to disrupt an inductive circuit for conversion into light. Since an exceedingly thin film (if this term may be so used) is a dielectric of such strength that a very small displacement results when it is disrupted, and the ether being the medium of minimum rigidity closes the "hole" the instant it is pierced. Such a medium for such a purpose is almost incomparable to air or oil, which becomes volatilized.

(*To be Continued.*)

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CONTENTS.

SUMMER VENTILATION.

When a man is bound to his desk all summer the prospects are not very encouraging. Perspiration and inspiration are not so strongly allied, that with one we always find the other.

Yet a relief is within the means of all men; the ink bottle and fan-motor are the best of friends by this time. Some are still prejudiced against the fan. "The deadly current," they say, or "it will cut off your fingers." A man to buy a fan motor must lose some "bones," but not necessarily finger bones.

A relief from oppressive heat and a sudden revival from a condition of deep martyr-like suffering is achieved by the ownership of a fan-motor.

The sweltering weather is now at hand; the intermissions will become shorter and shorter. Those that cannot borrow current may indulge in battery outfits, and thus save themselves from the horrors of slow dissolution. They add a large element of happiness to a man's life. When one is accustomed to misery he is apt to not fully appreciate its absence.

An East Indian Prince, for penance, once resolved for seven years to sleep on a bed composed of knobs. They were made of thick, hard rhinoceros hide. When the time had expired he felt so comfortable that he would not change his couch, and even pitied his friends because they would not indulge in the same luxury.

A heated office, with a prejudiced man inside, fits these circumstances.

The advice, "keep cool," might be well changed to "keep a fan."

OSCILLATIONS.

There can be financial as well as electrical oscillations. The cause of the disturbance may be different, but the effects are equally as noticeable. We are swinging in mid-air at present weighted down with silver bullion. The rope we hold so tightly in our hands is made of gold braid. If there were a lighter breeze from the West our hopes would be higher, but unfortunately it is blowing us over an abyss that in tragic parlance "yawns to receive us." If we could feel sure that it yawns to deceive us, we would be content to allow that anatomical demonstration to continue for ever. Yet the truism is comforting "that change is inevitable" at such a period as this.

SKETCHES FROM THE EXPOSITION.

The exposition has blossomed forth in all its glory. There are but few fairs that have had so much popularity as this one. When a stranger enters, the blaze of light, the interminable crowds, the long lines stretching from the Niagara telephones, the X ray and Moore room, give at once the impression that if a crowd is a sign of success the fair has certainly succeeded. On wandering through the aisles below it is amusing to watch the crowd surveying with wonder the cooking apparatus. It is undoubtedly an appalling sight to the spectacled old dame from the country. To see a cylindrical support on which a crystal glass rests filled with boiling water, and the egg within getting well cooked! No fire—nothing visible but a slender cord. She reaches out her hand and touches the metal support with moistened finger tip. It is hot, as hot as a stove. When she inquires into the cause the attendant answers: "Electricity does it, ma'am." She goes away with a look of wisdom on her face. One can almost trace the thoughts passing through her mind—the admiring circle of friends to whom she tells the thrilling tale, of an egg boiled without a fire.

A ministerial-looking individual joined the ranks slowly working their way toward the Moore room of etheric lighting. His white tie and black coat were in striking contrast to his heated countenance. The room was finally reached, and the small group admitted saw the inky darkness swept away by the long, white tubes of light. The ministerial party was much impressed by the appropriateness of the sign: "Let there be Light." He stood there absorbed in religious meditation. It might have lasted very long and carried him far away to a world of delicious reverie had not the spell been broken by a sarcastic voice which ironically misquoted the ancient words: "Let there be Moore light." Before he could turn round in righteous indignation the policeman moved in the next batch and he was hurried out with the last.

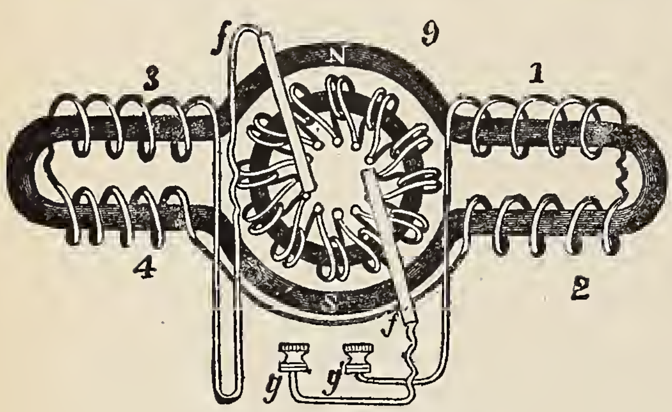
In passing the enshrined harp, a crowd of deeply-interested listeners were observed. The automatic piano was playing its crack tune. A pair of jovial college companions were watching the moving keys with twinkling eyes. It was a lively melody they heard, but an old gentleman in front was not escaping their notice. "Shure," he said, addressing the crowd in general, "It's spirits that's playing it." His eye had by this time rested upon the two boys near him. "Yes," they answered, in chorus, "We think you are right—the spirits of Ether." The old gentleman is still trying to find out the meaning of their reply.

THE MOTOR.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

A motor to satisfy the demands of modern design must fulfil certain functions. In earlier days Page made a motor which depended upon the suction or attraction of a helix for a soft iron core. The entire mechanism otherwise represented the details of a steam-engine. The slide-valve was duplicated by means of a contact-piece. Although the apparatus rotated, producing power and motion, it was not efficient, or at present more than historically interesting. From the first experiment of Œrsted sprang a host of inventions. Jacobi, working under the patronage of the Czar of Russia, built a small boat run by a motor which was used on the river Neva. In Germany many machines were produced that clearly showed the easy transformation of electric into mechanical energy. In America, Froment and others set to work constructing small motors for practical purposes. A motor is today the most efficient machine in existence. Its principle of action is not less interesting than singular. In one respect it departs from the regular beaten path in utilizing power in a unique manner. Stripping the machine of all elaborations, it is to be seen that the attraction and repulsion of magnetic poles



CONNECTIONS OF MOTOR.

causes the rotation. It is necessary to have in every motor a source of magnetic power. No matter how rude the construction, this is an essential part of the device.

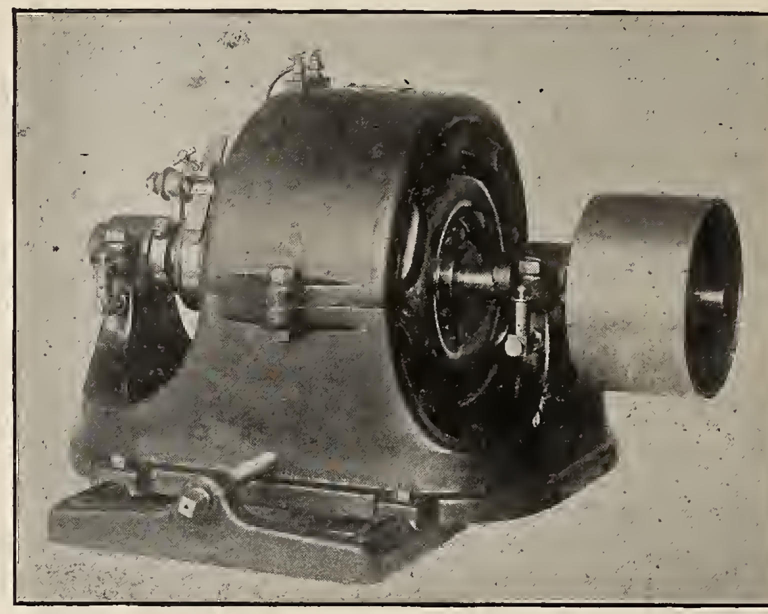
A bar of iron may be rotated in front of this magnet, attracted to a certain point, and then by means of its own momentum allowed to swing around and present its other end for attraction. In so simple a contrivance we have the elements of a modern motor. To enable the current to act in order that the magnetizing effect is automatically supplied when needed, a commutator is used. A switch which controls the current, acting by means of rotation, is the addition required. In large motors the field is kept constant. When a motor is started the field is the first part energized. The necessity for this will be explained later on. When the field is ready, rotation of the armature ensues as soon as current is let into it. The armature consists of a cylindrical body of iron upon which is wound coils of wire. These coils are connected to a commutator so that they are each individually attracted in rotating through the field. The armature is nothing more nor less than a compact form of magnet with innumerable poles.

If the armature rotates in a magnetic field, it does so because each of these coils individually are attracted by the current; this is effected by having a series of metallic strips composing the commutator connected to the ends of each coil. When these coils are made magnetic they move towards the nearest oppositely magnetized pole piece and rotation at once ensuess.

This process is regularly occurring with every coil, and results in a rapid and even spinning of the armature.

In considering the dynamo it was observed that the conductors cutting lines of force generated an electromotive force. In a motor we also have conductors cutting lines of force; therefore an electromotive force is likewise produced.

It is necessary to appreciate this fact in order to understand the scientific meaning and bearing of the term efficiency. If the electromotive force generated in a motor while rotating were by any possibility equal to the supplied the motor would stop. There is always a difference between them, however, which depends upon the load of the motor.



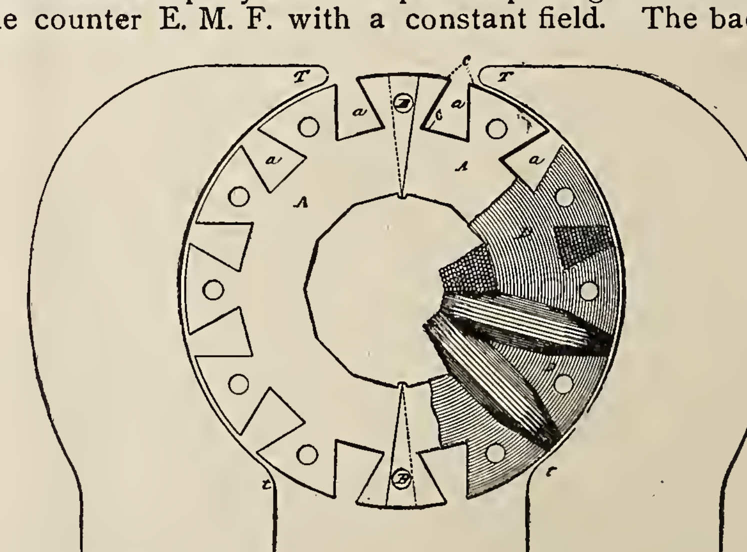
TYPE OF MOTOR.

If 100 volts were applied to the motor it might generate within its *armature* 90 volts; therefore only 10 volts can be effective in forcing current through it. The resistance of the armature must be low enough to allow sufficient current to pass at 10 volts pressure to do the work required. This adjustment is continually occurring between the load on the motor and the pressure generated within it. In this respect a motor is perfectly automatic and requires but little outside aid in certain types to overcome many difficulties hampering the speed.

The pressure created in the motor by its armature rotation is called *counter or back E. M. F.* The ratio existing between the counter and back E. M. F. is a measure of the *electrical efficiency* of the motor.

$$\frac{\text{Back E. M. F.}}{\text{Applied E. M. F.}} = \text{Electrical Efficiency.}$$

The more rapidly a motor speeds up the greater becomes the counter E. M. F. with a constant field. The back E.



METHOD OF WINDING ARMATURE.

M. F. becomes more and more identified with the applied E. M. F.

The armature takes less and less current, and in electrical efficiency the motor approaches its ideal value.

The *commercial efficiency* is the ratio existing between

(*Continued on page* 271.)

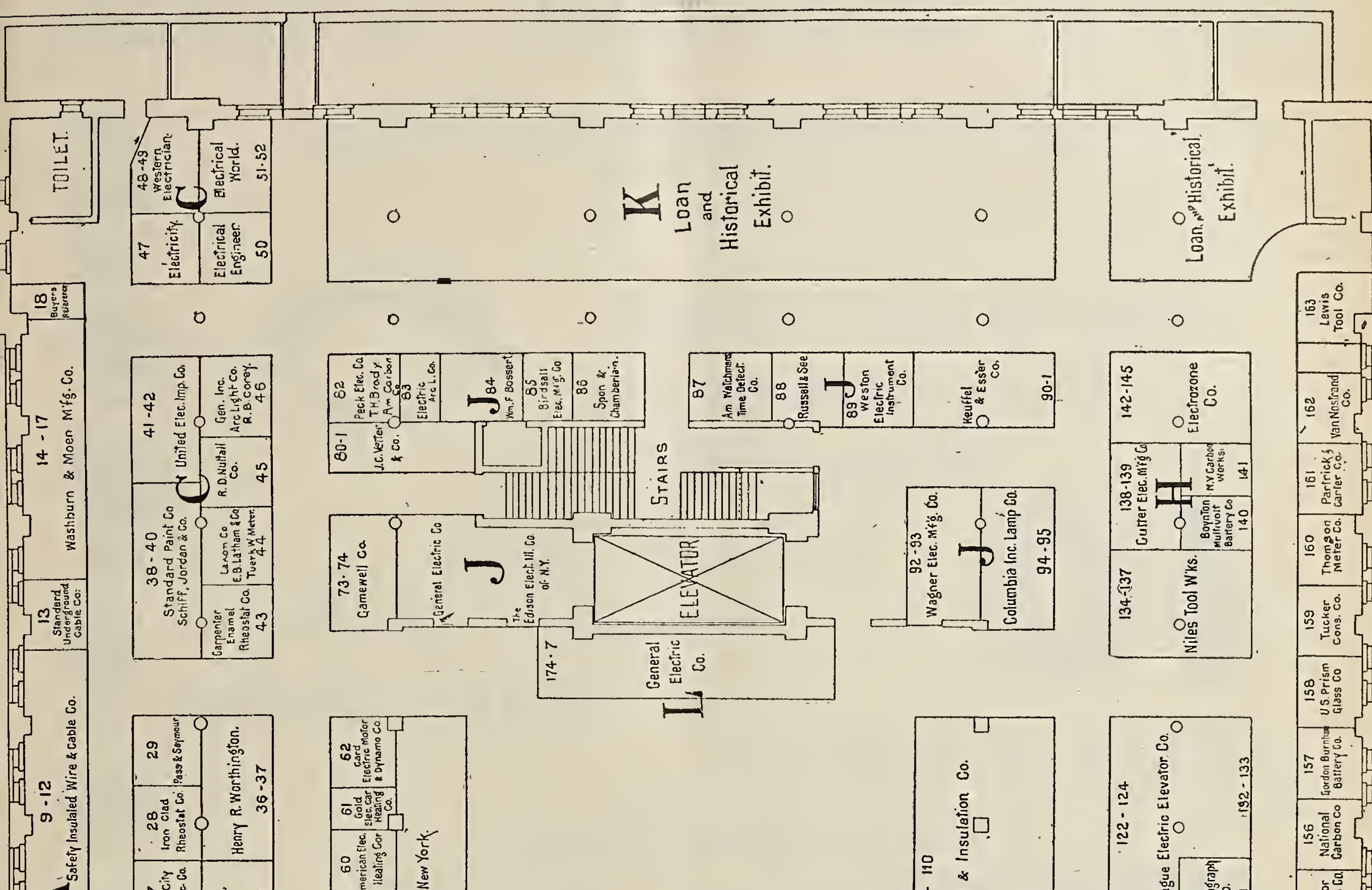


DIAGRAM OF MAIN FLOOR OF EXPOSITION, GIVING NAMES OF EXHIBITORS, NUMBER AND LOCATION.

PRINCIPLES OF DYNAMO DESIGN.

BY

Newton Harrison E.E.

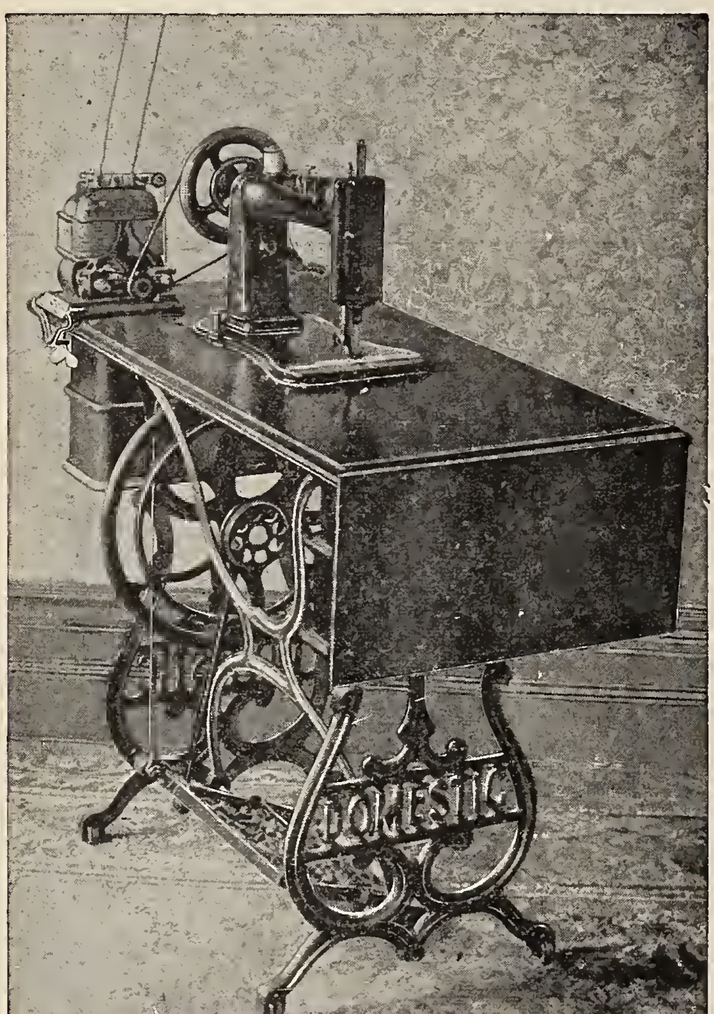
(*Continued from page* 256.)

The principles followed for the purpose of illustrating the means, applications of motors and dynamos to the different branches of art and commerce need only be briefly stated.

It has been desirable to show the many means at hand for the use of generating and power-producing machinery. In the country the dynamo has found a new and useful field in homes In the city it is an almost necessary adjunct to every large house. There is in certain departments of surgery great demand for engineering devices, motors for running saws, drills and trepanning instruments.

These particular applications call for but slight modifications in the design of either dynamo or motor.

In the past review of machines and devices requiring current and power, the object in view has been that of ac-



ONE OF THE COMMONEST APPLICATIONS.

quainting the reader with a vast field of new industries that have been originated and strengthened by the progress of this science.

Various designs of dynamos, created to meet the demands of different maufacturers of goods, have for the last five years occupied a fixed position on the market. Novelties by the thousand have cropped up and the so-called Yankee inventor has found a rich harvest in the eastern towns.

It is not alone the element of usefulness which is satisfied, but the beauty and finish of many small electrical contrivances has made a name for them all over. The desk-fan with its soft murmur has proved a source of unexcelled comfort to the merchant. Many little things that escape the notice of the inactive mind prove a source of wealth to the enterprising man.

In thus gazing back reflectively over the past work in the field of dynamo design, it seems but proper to interpolate a few additional facts that have not received the proper attention.

The motor, which represents in every sense a type of machine of excellent design, is one in which not only mechanical but electrical features are satisfied.

In a running motor the electrical efficiency to a great extent determines the commercial. If the first is high the second may possibly be so likewise. In order to calculate the back E. M. F. of the motor, the resistance of the armature and current flowing into it is necessary to know. To illustrate, supposing an armature has

Resistance = 2 ohms.
Current = 20 amperes.
Pressure = 110 volts.

The back E. M. F. is calculated as follows :

Volts in armature allowing 20 amperes to pass $= 2 \times 20 = 40$. (*To be Continued.*).

ROENTGEN RAYS.

A Disruptive Discharge.—The spark of the disruptive discharge is usually a thin, brilliant streak of light. When it takes place between two metallic balls, separated only by a short interval, it usually appears as a single thin and brilliant line. If, however, the distance be as much as a few centimeters, the spark takes an irregular zig-zag form. In any case its path is along the line of least resistance, the presence of minute motes of dust floating in the air being quite sufficient to determine its zig-zag character.

A Forked Spark. — Often the spark exhibits curious ramifications and forkings. Photographs of lightning flashes almost always show similar branching. The branches always point toward the negative electrode. The discharge from a Leyden jar affords a much brighter, shorter, noisier spark than the spark drawn direct from the collector of a machine. The length depends upon the potential and upon the pressure and temperature of the air in which the discharge takes place. The brilliance depends upon the quantity of the discharge.

Vacuum Discharges. — The discharges in vacuum tubes are affected by the magnet at all degrees of exhaustion, behaving like flexible conductors. Under certain conditions, also, the discharge is sensitive to the presence of a conductor on the exterior of the tube, retreating from the side where it is touched. This sensitive state appears to be due to a periodic intermittence in the discharge ; an intermittence or partial intermittence in the flow would probably account for the production of striæ.

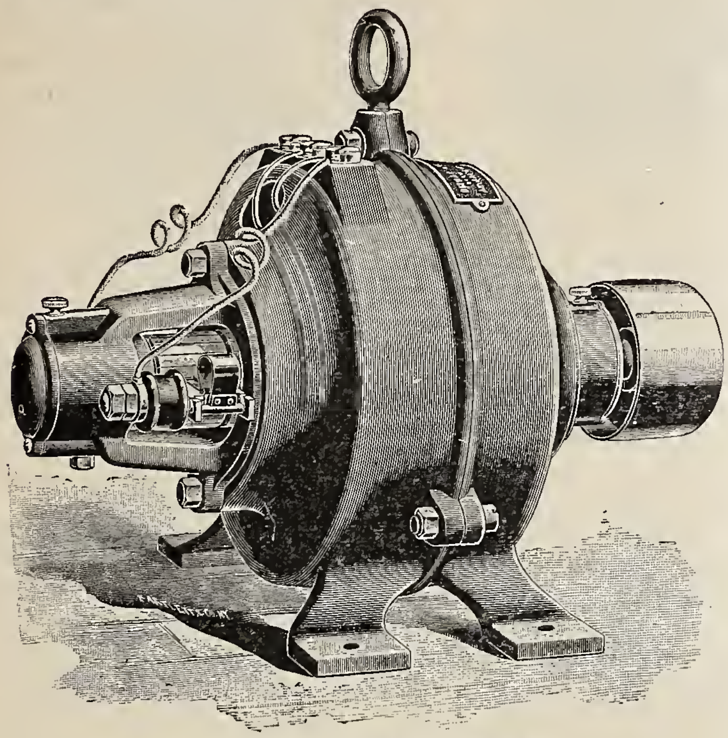
Velocity of Electricity.—There is no definite assignable "velocity of electricity." In the case of wires suspended in air the velocity of propagation of any rapid electrical vibration is equal to the velocity of light. But in the case of slow vibrations, like those of telephonic sounds being sent through land lines or cables, the velocity may be much less.

Maxwell's Theory. — In 1867, Clerk Maxwell put foward the theory that the waves of light are not mere mchanical motions of the ether, but that they are electriecal undulations.

The Mounting of a Sword.—The finished blade may be mounted with a hilt, a guard, a ferrule and a scabbard, and the scabbard has certain fittings. The different parts have each its own name, and many of them are made highly artistic, particularly the guard, the metallic ferrules about the hilt and scabbard, and the metallic handle of the small knife inserted in the ouside of the scabbard of many short swords. The knife is used as a last resource, to throw at the enemy in battle, or to cut his throat when he is down, and in peace is used as a paper-cutter. There is likewise a small metallic skewer inserted in the scabbard of those swords. It is used, in the heat of battle, to stick through the ear, into the head of a slain enemy for future identification, or to carry his head for presentation to the victor's lord. Occasionally the skewer is split lengthwise into two parts and can be used as chopsticks.

(*Continued from page 268.*)

the power obtained from the motor and the power applied. A motor cannot have a high commercial efficiency with a low electrical efficiency.



A STANDARD TYPE OF MOTOR.

$$\text{Commercial efficiency} = \frac{\text{Power received}}{\text{Power applied.}}$$

Each watt entering the motor equals 44.2 ft. lbs. The power applied can therefore be calculated. The power received from the pulley of the motor is obtained by means of a brake. It also represents foot pounds. In large motors this may be equal to 90 per cent ; the electrical efficiency may equal 95 per cent. in the same machine. To test a motor its load is entirely applied and the volts and amperes it consumes measured. The speed of the motor is taken and the pull in pounds measured on the periphery of the pulley. If the following data be considered the process will not be confusing.

Test of a motor. volts, 100
amperes, 10
speed, 2,000
pull, 5 lbs.
pulley = 1 ft. diam.

$$\text{Power entering} = 10 \times 100 = 1{,}000 \text{ watts} = 44200.0 \text{ ft. lbs.}$$

$$\text{Power received} = \frac{\text{Circumference of pulley} \times \text{speed} \times \text{pull}}{33{,}000}$$

$$= \frac{3 \text{ ft.} \times 2{,}000 \times 5}{33{,}000} = \frac{30{,}000}{33{,}000}$$

$$= \frac{9}{10} \text{ H. P.}$$

The commercial efficiency therefore is quickly found.

$$\frac{\text{Power received}}{\text{Power applied}} = \frac{.9 \text{ H. P.}}{1 \text{ H. P.}} = 90 \text{ per cent.}$$

(*To be Continued.*)

PLAINFIELD, N. J.—The Plainfield Street Railway has been asked by New Market people to continue the extension of the line now in progress toward Dunellen to New Market. This will make four miles more of double track and connect two thriving towns with Plainfield.

NEW YORK CITY.—Madison Square Garden is to have an ice-skating rink on the roof. It will occupy the Madison avenue section of the roof. Plans were prepared by architects McKim, Mead and White. Estimated cost, $75,000.

Interesting Facts in Science.

Influence of Temperature and Electrification on the Insulating Power of Gutta-percha.—A series of articles on this question is completed in the "*Elektrotechnische Zeitschrift* of February 6. The investigation was undertaken by Mr. H. Zielinski in order to determine why the resistance of the older cables remained pretty steady throughout the year, whilst some newer cables showed a greater resistance in summer than in winter. The experiments were begun in 1893, and continued during the year 1894. The subject has more a scientific interest, inasmuch as the final results prove that we may assume an average temperature coefficient for different sorts of gutta-percha, because the probable errors in taking measurements would balance any deviations from the normal. Mr. Zielinski experimented with specially prepared cables, about one mile long ; one of his cables had a length of almost three miles. These he heated in special thermostats, determining the resistances both during the rise and the fall of temperature. It may not be superfluous to mention in this place that the Germans call a thermostat a case in which a constant temperature can be maintained, whilst the English-American definition of the term is an apparatus by means of which the temperature is kept constant. The dampness of the ground has something to do with the variations in the resistance ; if moisture does not affect a well-insulated cable, it often affects the auxiliary instruments.—*Trade Journal Review.*

A Pocket Light.—A number of electric hand lamps of various sizes and shapes have been patented and are constructed by an electrical engineer in Vienna. These lamps come in the shape of bottles, clocks, opera glasses, in fact, in any desired shape, but are all constructed after the same principle. The neck of this bottle contains a small battery in which three pairs of platinum and zinc elements of the smallest possible size are concealed. This battery has a six-volt tension, and furnishes a current of from four to five amperes intensity. A minute incandescent lamp is connected with the poles of the battery, and protected by a knob of cut glass, the lower part of which is silvered and acts as a reflector. The body of the bottle contains the reservoir, in which a fluid, which is furnished by the inventor of the apparatus, is kept. When the light is to be used the top containing the battery is screwed off, and the bottle is filled about half way with the fluid. When the top is screwed on again tightly the lamp is ready for use. As soon as it is inclined so that the fluid reaches the battery, the electric circuit is closed, and the incandescent lamp glows with a white and brilliant light. No sooner is the bottle replaced in a vertical position with the knob up than the light will be extingushed. When the lamp is not in use there is no waste of material, and the smallest-sized bottle will furnish a continuous light for about half an hour. The inventor furnishes with the lamp a bottle of fluid sufficient for eight fillings at a cost of fifty cents.—*The Tradesman.*

Japanese Test of a Sword.—The usual Japanese tests of a sword are on the human body, or corpses of beheaded convicts or in the beheading ; or by ruffians on beggars and peaceable wayfarers ; or even on a dog. But Hütterott, from whose elaborate account many of the foregoing facts about Japanese blades have been taken, in his zeal tested some good swords on metal. With a blade of Mino he cut through at one blow, without injury to the edge, five *tempô* coins piled one on another, in all a full ½ inch thickness of bronze, and 1¼ inches wide. The same sword, struck upon a piece of hard wrought-iron about ¼ inch thick and over ½ inch wide, cut about ⅛ inch deep and became notched. At a second stronger blow it cut about the same depth and broke in two at the point struck. A good Satsuma blade could only cut through four *tempo*, and broke at the third blow on the wrought iron, after getting large notches by the two other blows without cutting very deep ; but an inferior Kiyoto sword, that could only cut through three *tempô*, endured three blows on the wrought iron.

EXPOSITION NOTES.

THE EXPOSITION BUILDING.

THE exposition is booming along better than ever. None are more satisfied with it than the New Yorkers. It is a pretty hard thing to stimulate a Gothamite's curiosity nowadays; yet if you visit the exhibition and see the craning necks and absorbed expressions you will readily believe that the residents of this large city are not yet too *blase* to enjoy a wholesome and refreshing treat.

Huebel & Manger, of Brooklyn, have a fine show of their goods to the right of the main entrance which visitors comment on. The fine line of bells and push-buttons, which are enclosed in a large and handsome oak case, attract attention. The 15-inch gong, especially toned to be heard through a hotel or large building, for fire-alarm purposes, is one of the features of this display. W. W. McChesney is looking after visitors.

M. M. Hayden, superintendent of the electrical department of the National Carbon Company, of Cleveland, O., had a great surprise for his many friends at the convention. It seems that he was in St. Louis on business when imperative orders were received for him to go to New York and take charge of the exhibit. Having arranged to be married in June he telegraphed his fiance, Miss Quine of Cleveland, and hastened matters so effectually that he was married immediately on his arrival in Cleveland on Wednesday night, leaving a few hours after for New York. Mrs. Hayden is prominently known as a church singer in Cleveland. Mrs. Hayden's taste is shown in this handsome booth.

The United States Prism Glass Company, of the Havemeyer Building, New York, exhibit a beautiful line of their globes over incandescent lamps. They are attracting the attention of buyers in this line and a great future is assured the company. Mr. W. Pond, the genial salesman, looked after visitors and he was kept busy explaining the virtues of the globes.

E. B. Latham, thc enterprising New York manager of the Lakon Company, was busy extolling the strong points of converters that convert and don't dissipate all the "juice."

The Gould Manufacturing Co., of Seneca Falls, N. Y., has a working exhibit of pumps which were handled in a manner which gives a complete idea of the apparatus.

Near the main door of the exhibition is the Westinghouse Electric Manufacturing Company, of Pittsburgh. A beautiful red and gold sign suspended above the exhibit attracts attention. Tesla motors and other Westinghouse apparatus are plentifully in evidence. A. C. Zimmerman, of the New York office and M. MacLaren, from the Pittsburgh factory, are in charge of the exhibit. Mr. MacLaren had been especially detailed to look out for the power transmission from the Niagra Falls power circuit. The company has on exhibit a lamp-board, in the centre of which is seen the Shallenburger electric meter.

ECLIPSE Lamp Company, of Buffalo, N. Y., have opened their exhibit with a full line of carriage and bicycle lamps. They are on the X-ray floor and attract a continual crowd. It keeps two attendants busy explaining the advantages of their bicycle lamps over any other style of lamp now in use. H. H. Eldred is in charge.

"Kerite" is the popular brand of insulated high grade of wire, which received the only medals at the World's Fair for rubber insulation; and a most cordial greeting was extended at the headquarters, at the Murray Hill Hotel, to the visiting delegates by W. R. Brixey, general agent, J. E. Ham and E. H. Stanley.

The Washburn & Moen Manufacturing Company, of Worcester, Mass., has a very large space devoted to the showing of its numerous lines of manufacture. Several show-cases are filled with beautiful designs of wire, while numerous large reels of cables and new style trolley wire are arranged about the display. The booth is decorated with flags and bunting, with Mr. Willis the favorite salesman.

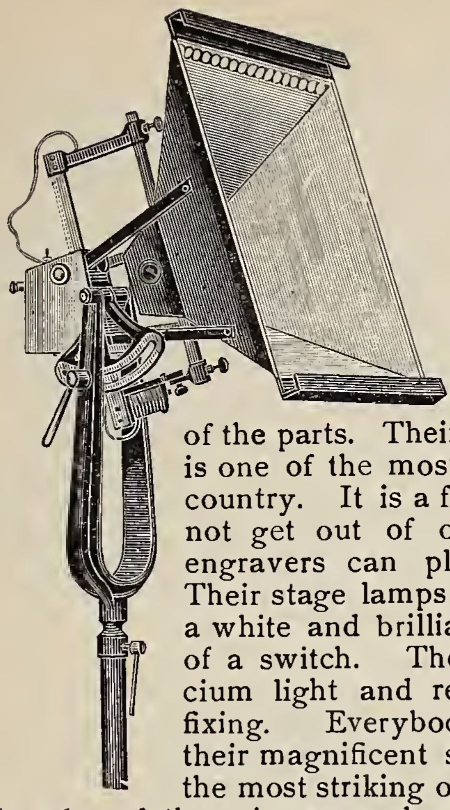
The Joseph Dixon Crucible Co., of Jersey City, N. J., has a complete line of graphite for use in the electrical trade, at its booth. Graphite resistance rods were one of the strong talking points of Fred. Engelbrecht, who has charge of the exhibit, while an assistant presents a mammoth pencil, which is called the "Uncle Sam" to all who apply. The many electrical uses of graphite are courteously explained.

Horace See, of New York, has an interesting exhibit of an electrical indicator system, especially designed for use on steamboats, to be used as a warning of the failure of any electric light to burn in any portion of the ship, whereby a bell is rung and an indicator locates the position of the defective lamp.

The Eddy Electric Manufacturing Company, of Windsor, Conn., through its New York agents, H. B. Coho & Co., installed one of the most attractive working exhibits of the exhibition, being one of its 40 kilowatt multipolar direct-connected dynamos to an Ideal automatic self-oiling engine, both of which are resting on three steel points, raised five inches from the foundation, being in no way bolted. This combination attracts great attention, because there is no perceptible vibration or jar when under any rate of speed. Secretary A. D. Newton and General Manager M. E. Baird of this company are exceedingly busy men in extending that cordial greeting for which they are so well known.

The Jewell Belting Company, of Hartford, Conn., has one of the most tastefully arranged booths on the ground floor. On the back wall is a sample of its renowned four-ply Jumbo belt, which was sold to the Washburn-Moen Manufacturing Company, of Worcester, Mass., which is 79 inches wide and weighs 3,208 pounds. A three-ply 69-inch belt, purchased by the Norwich Electric Light Company, and a two-ply 48-inch belt, purchased by the Passaic Lighting Company, forms a portion of this company's exhibit, and shows the high grade of belting which this concern manufactures. Treasurer C. E. Newton and General Sales Agent C. L. Toles of Hartford, and the New York manager, C. E. Ainsworth, were kept busy a large share of their time by friends asking for their beautiful souvenir pocket-book.

General Manager C. E. Trump, of the Novelty Electric Co., Philadelphia, was about the electric show last week; with his eagle eye.



J. B. Colt & Co., 115-117 Nassau street, city, opened their exhibit this week with flying colors. They are showing a large line of magic lanterns, theatre stage lights, focussing lamps, etc. The popularity of J. B. Colt & Co.'s goods is due to the excellent finish and reliable workmanship of the parts. Their photo-engraver's lamp is one of the most generally used in the country. It is a focussing lamp that will not get out of order and upon which engravers can place their dependence. Their stage lamps do not flicker and cast a white and brilliant light at the turning of a switch. They far surpass the calcium light and require no preliminary fixing. Everybody is acquainted with their magnificent stereopticon; by its aid the most striking optical effects have been produced, and the microscope has added a new and surprising element to such work. Some of the most artistic of stage effects have been produced by means of a device which throws a bewildering change of the richest colors on either dancer or scenery.

Their goods indeed merit every consideration and are recommended by all users.

The Bernstein Electric Company, of Boston, Mass., has a working exhibit of its widely-known incandescent lamps of all colors and sizes, arranged in series and to work upon all systems for interior or street lighting. General Manager H. J. Cram receives the visitors.

General Superintendent J. F. Blausett, of the New England Butt Company, of Providence, R. I., which is so well known in the electrical trade for the excellence of its winding machines, could only spend one day at the convention, but he crowded in an unusual amount of work in that time. Arrangements were about perfected by this concern to show its apparatus, but it was prevented because of several rush orders which came at a time when it could not arrange matters satisfactorily.

The Metropolitan Telephone and Telegraph Company, of New York, gives a working exhibit of the local and long distance telephones. Public booths and a complete sub-office of this company are established, and a large corps of obliging gentlemen shows the practical workings and mechanical construction of the telephone.

General Superintendent S G. Booker of the Phœnix Carbon Manufacturing Company, of St. Louis, Mo., was in evidence everywhere, and the genial hospitality which he extended at his headquarters was, as usual, second to none. A convention without Col. Booker would have an element of social enjoyment missing.

The commutator bars and other necessary things in tempered copper exhibited by the Forest City Electric Company, of Cleveland, Ohio, tastefully arranged upon a large board at its booth, excite much favorable comment from delegates and others interested in this class of work. Strong statements are made for the purity of this production.

Chas. Y. Flanders, the genial representative of Morris, Tasher & Co., Philadelphia, the well known manufacturers of iron trolley and electric light poles, etc., was one of the most active men at the convention.

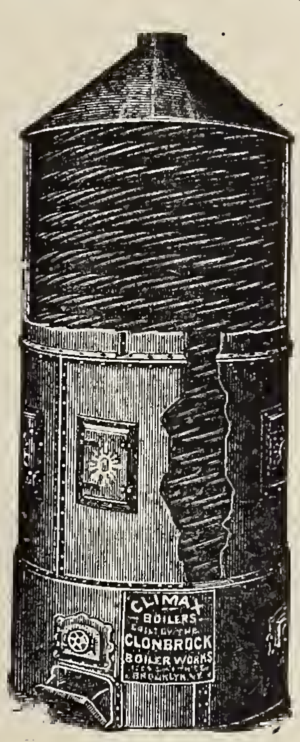
The Sprague Electric Elevator Co., of the Postal Building, New York, show a complete line of commercial and private residence electric elevators. We can remember, in 1884, Philadelphia Electric Exposition, when Mr. Sprague began his successful careerwith a big display of his motors connected to several varieties of machines.

The Mica Insulating Co., and the well-known house of Eugene Munsell & Co., of New York, exhibited a large line of plain mica, and micanite commutator rings; also micanite sections for all parts of motors and dynamos.

H. E. & C. Baxter, of Brooklyn, N. Y., had a representative who was busily employed in giving directions as to where their factory could be reached, at which place the practical demonstration of their bells and various electrical supplies were shown. Their goods are well known and they did not consider it necessary to make an exhibition when they are at present so rushed to meet orders.

W. S. Hill of Boston, Mass., was a welcome visitor to the convention. Being one of the veterans of the electrical trade, he was surrounded a large share of the time by his many friends. Mr. Hill was a close investigator of the various exhibits.

Stanley & Patterson of New York exhibit one of the most complete lines of general electrical equipment to be seen in the hall in a booth decorated in a very original manner. The pillars and ceiling are decorated with incandescent lights in different styles and colors. This is the only electrical supply house in New York having an exhibit. A. F. Stanley and G. L. Patterson are in constant attendance.



ONE of the most notable exhibits on the X Ray floor was the Climax boiler. They had numerous photographs showing different installations hung about the exhibit, while the new catalogue, only a few days from the press and profuse in illustrations, was in great demand. The letters, from some of the most prominent men in the electric lighting field, are especially strong endorsements of the Climax steam generator. John Mason is in charge of the headquarters, while General Manager S. V. Morrin is in attendance. On May 9th an invitation was extended to visit the United Electric Light & Power Company's plant and passes were issued to those desiring them. A handsome souvenir showing the boiler in detail was distributed.

The American Electric Heating corporation of Boston, Mass., has space filled with every device for heating, and the practical demonstration of expert cookery keeps the space in front of their exhibit crowded at all times, when the exhibition is open. The New York manager, Levi L. Parsons, has a most obliging corps of assistants, who explain in detail the workings of the apparatus.

The National Carbon Co., of Cleveland, O., has the right man in the right place in general sales agent, M. M. Hayden, who arranged a very elaborate display of carbons. It is claimed that everything in the way of a carbon is shown by sample at this booth. A large number of old acquaintancess in the electrical trade extended their congratulations to Mr. Hayden for the fine exhibit which was presented.

C. H. BRIGHAM.

THE subject of this sketch, Mr. Charles H. Brigham is the popular manager of the Boynton Multivolt Battery Co., Greenwich and Cortlandt streets, New York. Mr. Brigham is well and favorably known to the trade for his suave manner and magnetic influence. He is pushing their popular battery to the front stronger than ever. Mr. Brigham will be found at his post of duty in the company's handsome booth at the electric show every night. The Boynton Company should feel great pride in having such a steady and ambitious manager, which foretells great success for their goods.

The Anchor Electrical Company, of Boston, Mass., has a splendid display of switches and lamp adjusters, and also shows a new incandescent lamp sign advertising device and mechanical gongs. The arrangement of the advertising sign over the booth was the subject of much favorable comment. This exhibit is most attractive. Vice-president Norman Marshall, General Manager H. C. Hawks and A. B. Field are in charge.

The Peck Electrical Company, of New York, makes a display which is of great interest. A model of an electric fire-engine made by the Birkett & McElroy Company of Brooklyn shows great possibilities. This company has recently been appointed agent for New York city and vicinity of the Helios Electric Company, of Philadelphia, for its arc lamps, and it had one of the latest Helios alternating lamps erected, with pole, fixtures and hood, and also direct current lamps. A large number of the T. H. Brady electrical specialties, manufactured in New Britain, Conn., of which this concern is the agent, are on exhibition.

The Columbia Incandescent Lamp Company, of St. Louis, has one of the most artistic incandescent signs which has ever been gotten up, and also an illuminated sign of the late Henry Goebel, and a case containing the different materials used in the construction of lamps. It has a full line of both regular and special lamps, arranged in various designs, and in the centre of a large table is a greeting "1896" in miniature lamps. President J. H. Rhotehamel and Secretary A. O. Garrison were in attendance from St. Louis. C. E. Bibber, the New England agent, is also greeting his many friends at this booth.

Watertown Steam Engine Co., of Watertown, N. Y., have the finest finished engine, it is said, of the electric show; all parts are polished and finished in nickel. The engine is direct-connected to an Eddy generator. This machine stood a 25-per cent. overload during the early days of the fair, as they were almost the first to have their apparatus running. Mr. Launcelot Copleston, the well known mechanical engineer, with his usual ability put up this plant, and it is running under his supervision to supply current for exhibitors. Mr. Copleston's office is in 39 Cortlandt street, N. Y.

Edison's X Ray Light is creating a large attendance at the exposition. The visitors stand in line by the hundreds waiting to see their bones. As the people flock into the dark room, officers call out: "Hold your pocket-book before the light and see how much silver there is in it.

McFarlan Moore's daylight room attracts unusual attendance. This beautiful bower of light is worth seeing. Mr. Moore has a room over the main entrance, all fitted out with glass tubes. After a dozen people have entered this room, Mr. Moore gives the signal and in a few seconds the room becomes flooded with a clear, white, pleasing light.

Edison and Bell were at the exposition Saturday night, May 9; they both took a quiet survey of the exhibition without any difficulty. Edison refused to go on with the X rays that night as they did not suit him. Everything worked in all its glory, however, since Monday night.

Harrisburg Ideal Engine, installed by W. R. Fleming & Co., of 203 Broadway, N. Y. The electrical engineering contractors and N. Y. representatives of the Ideal engines, at the electric show, creates more attention than any other exhibit. The engine is set on three iron pedestals and is direct-connected to a large Eddy generator.

Payne Engine Co., Elmira, N. Y., and N. Y. office, 45 Dey street, exhibit their improved Compound Engine, direct-connected to car and dynamo. It runs very smoothly. Messrs. Payne Brothers are in constant attendance.

Riker Electric Motor Co., Brooklyn, N. Y., exhibit one of their Multipolar Generators direct-connected to a small case engine; also their new 1896 Fan Motors. This is one of the neatest exhibits at the electric show.

Ernest H. Heinrichs, the well-known Press agent of the Westinghouse Electric and Manufacturing Company, had his business eye wide open, and nothing of importance passed his vision.

W. F. Bossert, of Utica, N. Y., has a fine show of his new cut-out junction boxes and also his new conduit boxes. They can be locked with door in front to prevent light-fingered people from injuring the system.

The General Incandescent Arc Light Company, of New York, under the management of Messrs. R. B. Corey and H. Harrison, made a beautiful display of their goods; a rich cluster of arc lamps and other features attracting great attention to this exhibit.

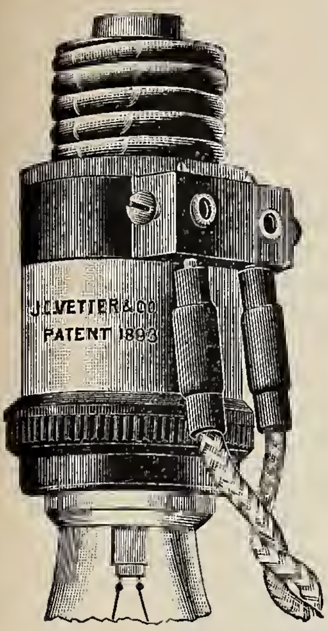
The American Electric Works kept open house at their New York office, during the N. E. L. A. meeting.

The Peru Electric Manufacturing Company, of Peru, Ind., arranged a booth which attracted general attention, showing its various porcelain specialties. General Manager R. H. Borislog and Superintendent D. A. Schutt, were in charge of this company's headquarters.

The Holtzer-Cabot Electric Company, of Boston, Mass., has an extensive exhibit of motor fans and direct-current ceiling fans. The lightness of these fans caused much comment as the company guarantees none will weigh over 30 pounds. The company's full line of motors and general supplies were also on view. President C. W. Holtzer and C. E. De Lue, of Boston, and the New York manager, David Chalmers, are in charge of the exhibit.

The Varley Duplex Magnet Company, of New York, make one of the most complete exhibits of magnets ever seen. Everything that one could desire in this line is shown. This concern from a small beginning has developed a very large business, and is becoming known East and West for the excellence of its products. General Manager Richard Varley is in charge, with several assistants, and a number of fine contracts have been taken.

The United Electric Improvement Company, of Philadelphia, has a working exhibit of its reactance system of arc lighting, in charge of the inventor, W. S. Horry, the electrician of this company. A handsome design of the company's well-known Keystone incandescent lamps, in connection with its arc lamps, attracts a great deal of attention. Vice-president and General Manager Walter F. Smith is in attendance, assisted by his son, Eugene Smith, assistant electrician of the company.



J. C. VETTER & CO., 104 West 23d street, New York, exhibit a fine line of electro-medical apparatus. Their adapter, as shown in the illustration, can be used to run dental and surgical apparatus, motors, etc.; it is run with lamp resistance in series. They exhibit the medical cabinet shown in our May 2 edition. To go into details about this exhibit would take to, much valuable space. Their exhibit, seen on the main floor, will be fully appreciated by all.

The Chaplin-Douglas Electric Co., of New York, has a very complete exhibit of electrical supplies attractively arranged about its booth, and has many calls for printed matter.

The Pennsylvania Slate Co., of New York, has a beautiful exhibit of its productions for use among electrical men. The design and finish of the products are of very high quality.

The Gold Street Car Heating Company, of New York, has electric heaters for street cars, boats and buildings on exhibition, and presents many facts in regard to the excellence of the system.

New Corporations.

McKEESPORT, PA. — An application will be made for a charter for the Monongahela Supply Co. The plant will be located in the Monongahela Valley, for the purpose of manufacturing and supplying light, heat and fuel in the county. John F. Wilcox will be manager.

HAVANA, N. Y.—The Supreme Court, at a special term, in Ithaca, as has been previously announced, granted to the Watkins & Havana Railroad Co. an application to change its name to the Elmira & Seneca Lake Railroad Company, and the State Railroad Commission granted the company the privilege of increasing its capital stock from $50,000 to $300,000. The company proposes to build an electric railway from Watkins to Horseheads, and it is understood that the work of construction will soon be commenced.

PORTLAND, ME.—A corporation to be known as the Fairbanks Electric Bell Buoy Co. was recorded. Capital, $200-000. President, C. E. Littlefield; treasurer, Charles S. Dennis.

NEW YORK CITY.—The Silica Hydro-Carbon Co., to manufacture material, etc., used for electrical conduits. Capital, $100,000. Directors, William A. Cassen, Isidore J. Pocher and William M. Graves of New York city.

NEW TELEPHONE COMPANIES.

CAMPBELLSVILLE, KY.—A new telephone company has been organized at Campbellsville, which will build a direct line to Lebanon.

GREENVILLE, S. C.—The Secretary of State issued a commission to the Home Telephone Co., of Greenville. Incorporators, George A. Browning, Julius C. Smith and D. P. Conyers. The capital stock is $4,000.

EDINBURG, IND.—The Citizens' Telephone Co., of Edinburg. The company proposes to operate telephone lines in Johnson, Shelby, Bartholomew and Brown Counties. Its capital stock $1,200.

Telephone Notes.

PETERSBURG, VA.—A movement is on foot looking to the establishment of a telephone line between Petersburg and Dinwiddie Courthouse.

MARQUETTE, WIS.— The long distance telephone line which now ends at Menominee, Mich., is to be extended to Escanaba Iron Mountain, Negaunee, Ishpening and Marquette.

PRAIRIE DU CHIEN, WIS.—The Crawford and Grant County telephone companies are extending their lines to Bridgeport, where they will join in a common line for communication over both systems.

DELHI, N. Y.—Samuel P. Wilber will put in a telephone exchange in Delhi.

TUSCOTA, ILL.—Tuscota is to have a telephone exchange.

SHELOCTA, PA.—Residents of Shelocta are agitating the question of a telephone line.

ANITA, IOWA.—The construction of a telephone line from Anita to Massena and Cumberland is contemplated.

MT. CARROLL, ILL.—A telephone line is talked of between Mt. Carroll and Stockton; also between Stockton and Elizabeth, then connecting with Galena.

HARBOR SPRINGS, MICH.—There is a project on foot to connect Beaver Island with the mainland by a telephone line. The proposed route is from near Middle Village, 12 miles northwest of this place, to the south end of Beaver Island, a distance of about 16 miles.

CURWENSVILLE, PA.—A new telephone line will be erected from Curwensville to Patton, Hastings, Spangler and Barnesboro.

PARIS, ILL.—There is a probability of Paris having telephone connection with Redmon, Dudley, Brocton and Cherry Point in the near future.

FOR UPTOWN TELEPHONE SUBSCRIBERS.

An uptown branch of the Contract Department of the Metropolitan Telephone and Telegraph Company has been established at 113 West 38th street (one door from Broadway), where all business relating to the supply of telephone service can be transacted as readily as at the main office at 18 Cortlandt street. There are 15,000 telephone stations in New York City. Metallic Circuit Service, Rapid, Efficient, Permanent, can be had from $75 a year.

TELEPHONE PATENTS ISSUED MAY 12, 1896.

559,792. Electric Switching Apparatus. William W. Dean, St. Louis, Mo., assignor to the Bell Telephone Company of Missouri, same place. Filed Jan. 24, 1896.

559,837. Electric-Telephone Transmitter. Nathan Bassett, Philadelphia, Pa., assignor of one-half to William F. Breitenbaugh, same place. Filed Nov. 14, 1895.

559,874. Telephone System. Walter F. Taylor, Montreal, Canada, assignor of one-half to Louis M. Pinolet, same place. Filed Aug. 3, 1894.

559,988. Telephone. Theodore Berdell, New York, N.Y. Filed Mar. 8, 1895.

559,989. Telephone. Theodore Berdell, New York, N. Y. Filed June 19, 1895.

559,990. Telephone. Theodore Berdell, New York, N. Y. Filed Dec. 7, 1895.

Ball & Wood, of 15 Cortlandt street, New York, are up to the times as usual with one of their popular Compound engines, direct-connected with a Siemens & Halske generator. The invariable favorite, C. R. Vincent, is on the lookout that no eagle eye passes his engine without seeing all the best points of their engine.

There is only one C. S. White at the show, and he had been anxious all the first two weeks of the show at the delay of the Walker Electric Company. At last they have their big generator running from one of Mr. White's Phœnix Compound Engines, and she is a beauty beyond compare.

C. W. Hunt & Company, 45 Broadway, New York, have their coal conveyer system in full operation, carrying coal to the Abendroth & Root Boiler plant. It is one of the main exhibits on the power floor. You cannot miss it. If you do not believe it will do the work, take a ride in one of the buckets and you will be conveyed in good shape to the boiler.

Jewell Belting Company, of Hartford, Conn., have a fine showing of their Jewell belting. Their belts are noted for their smooth and even running, and their smooth and even representatives at the exposition.

Charles R. Schieren, Jr., with his able assistants, Messrs. Atkinson & Company, are in constant attendance at their handsome exhibit of perforated and plain electric belting.

The famous Stage Receptacle is on exhibition at the electric show. It is the only one when placed in position in the floor that cannot be short-circuited by water or any other foreign substance that may be dropped or placed in it. The wearing part of entire receptacle is made of aluminum, giving it a decided advantage over all others as to strength and durability and lightness. Invented and manufactured by H. C. Jones, 219 & 221 W. 29th street, New York City, who attends the exhibit.

RECEIVER'S SALE.

Grand opportunity to buy Globes and Shades, in every style and color, for electric and gas fixtures. There will be a large stock of fancy shades, etc., sold May 27, without reserve, at the salesroom of L. D. Hatton & Co., 11 Murray street, N. Y.

ELECTRICAL and STREET RAILWAY PATENTS.

Issued May 5, 1896.

558,727. Electric Stand-Lamp. Robert Graves, Irvington, N. Y. Filed Feb. 25, 1896.

558,741. Trolley. James H. Rabbitt, Wethersfield, Conn., assignor of one-half to Daniel F. Murphy, same place. Filed Oct. 10, 1895.

558,749. Electrically-Controlled Gas Engine or Motor. George L. Thomas, Montclair, N. J. Filed Nov. 11, 1895.

558,750. Multiple Contact-Switch. Elmer H. Wright, Chicago, Ill., assignor of one-third to James J. Heckman. Charles C. Carnahan, and Albert H. Graves, same place, Filed Nov. 28, 1894.

558,758. Fastening Insulator-Brackets. Lauren S. Beardsley, Naugatuck, Conn. Filed Oct. 30, 1895.

558,793. Fender for Cars. William Everdell, Brooklyn, N. Y. Filed Jan. 13, 1896.

558,833. Car-Fender. Samuel W. Neall, Philadelphia, Pa. Filed Oct. 24, 1895.

558,868. Means for Reversing Trolley-Pole Supports. Harlan P. Wellman, Ashland, Ky. Filed Sept. 17, 1895.

558,869. Trolley for Electric-Railway Cars. Harlan P. Wellman, Ashland, Ky. Filed Oct. 1, 1895.

558,870. Electric-Railway Cars. Harlan P. Wellman, Ashland, Ky. Filed Nov. 5, 1895.

558,904. Electrolier. August Heck, Philadelphia, Pa., assignor of two-thirds to Albert Nusser and Frank Baingo, same place. Filed June 25, 1895.

559,176. Magnetizing-Box for Hair-Pins. Charles A. Hussey, New York, N. Y., assignor to the Electric Hardware Manufacturing Company, same place. Filed Aug. 22, 1895.

559,187. Electric Governor. Kempster B. Miller, Washington, D. C. Filed Feb. 25, 1896.

559,190. Electric Attachment for Paper-Ruling Machines. John McAdams, Brooklyn, N. Y. Filed Feb. 8, 1896.

559,223. Electric Boiler. Friedrich W. Schindler-Jenny, Kennelbach, Austria-Hungary. Filed Oct. 2, 1895.

559,232. Socket for Incandescent Lamps. Julius C. Tournier, Schenectady, N. Y., assignor to the General Electric Company, of New York. Filed Mar. 25, 1896.

559,240. Electrically-Controlled Clutch. Franklin A. Weller, Boston, Mass. Filed Apr. 20, 1892.

559,254. Electric Heel and Toe Protector. Jennie A. Blair, New York, N. Y. Filed Feb. 27, 1896.

559,255. Method of Electroplating Pure Nickel From Ferro-Nickel Anodes. David H. Browne, Brooklyn, Ohio, assignor to the Canadian Copper Company, Cleveland, Ohio. Filed July 29, 1893. Renewed Oct. 19, 1895.

559,256. Plowing by Electricity. Friedrich Brutschke, Charlottenburg, Germany, assignor to Fabrik Landwirthschaftlicher Maschinen F. Zimmermann & Co., Actien Gesellschaft, Halle-on-the-Saale, Germany. Filed Jan. 2, 1895. Patented in Germany Feb. 10, 1894, No. 79,281, and in Austria Oct. 5, 1894, No. 45/5,321.

559,269. Car-Fender. Peter Dunwald, Rio, N. Y. Filed Jan. 16, 1896.

559,271. Canal-Boat Propulsion. William Elmer, Jr., Trenton, N. J. Filed Dec. 16, 1895.

559,274. Art of Telephoning. Derick H. Fitch, Cazenovia, N. Y. Filed Nov. 29, 1895.

559,275. Trolley for Electric Cars. James L. Foster, Waterbury, Conn. Filed Sept. 11, 1895.

559,280. Circuit-Breaker. Morgan J. Griffith, Wilkesbarre, Pa. Filed Aug. 28, 1895.

559,282. Electric Lamp. Robert Hacking and George Brand, Nottingham, England. Filed July 20, 1895.

559,340. Combined Switch and Fuse-Block. Edwin H. Montgomery, St. Paul, Minn., assignor, by mesne assignments, of one-half to Mathias Thommes, same place. Filed Oct. 2, 1893.

The Electrical Age.

VOL. XVII., No. 22 NEW YORK, MAY 30, 1896. WHOLE No. 472

A LONG DISTANCE LINE.

EDISON POWER PLANT IN THE MOUNTAINS.

TRANSMISSION OF POWER OVER LONG LINES.

At present a great feat is being accomplished in New York. Power is being transmitted from Niagara Falls to the Electrical Exposition.

Over all these hundreds of miles the current is passing with perfect certainty. The amount is not of much practical importance, but the achievement holds the leading record.

When the earth was less civilized the application of its forces was a matter of trifling significance. With the growth of commerce and the greater exportation of other than raw materials, power began to be looked upon as a useful addition and assistance. Its aid in weaving and general manufacturing was great enough to merit the attention of all. The development of natural resources became a matter of necessity. The water-wheel and windmill were soon familiar accessories to the farmer and the steam-engine indispensable to the enterprising manufacturer.

A period that represents but a span in our history brings us back to days in which the rudest mechanism and the most primitive devices greet our sight. The old spinning-wheel, the potter's table and the melancholy sound of a creaking water-wheel, are still within the recollection of our oldest inhabitant. It has been civilization, they say, that has lifted the groping world to its feet ; it has been that without a doubt, but its assistance was secondary to a greater stimulus—power, whose advent has changed the methods and enlarged the commerce of mankind.

The application of power in cases where the source and point of consumption were separated but by a short distance was at first most common. When a waterfall lay several miles distant from a town it became a matter of interest to engineers to convey its power with as little loss as possible to places where its use would be beneficial. A thriving town depends upon its power supply, whether from coal or water, for its independence and growth. It has been often observed that a dead, inactive centre awakens to life and animation by having power at its command which had previously lain dormant. Many cases might be cited to prove that there is nothing so beneficial to either village town or city as a *ready* source of power. The development of power-transmission plants has been extensively carried out in the West. The new experiment, about to view its completion, of supplying power from Niagara to Buffalo will be the beginning of an extended system. A town miles away from water-power will be supplied with all the light and power it requires. At times doubts arise as to the most convenient means of transmission. They are generally formulated under the following heads:

Electrical,
Hydraulic,
Pneumatic,
Wire Rope,
Steam.

The last means of conveying energy is used in New York, though more for purposes of heating than of power. Hydraulic and pneumatic systems have been tried with varying degrees of success. It seems that their use in common with wire rope for the transmission of power is limited to short distances. It has proven successful under circumstances which were propitious. It would not always be best to use. For nearly all cases, without special requirements being necessary, electrical methods have proven their efficacy beyond a doubt.

It is therefore not only reasonable, but inevitable, that electric-transmission plants supersede all others in the near future.

The conditions, limiting the amount of power received from a given source, are very easy to understand. A loss of pressure occurs throughout the wire, by its effect reducing the available power 10, 20, or 30 per cent., as the case may be.

The power supplied to a wire may be carried along without much loss, but the expense would be so great that practice would forbid it. Take the case of a motor, dynamo and line, each having 10 per cent. loss throughout. Starting with 1,000 h. p. at the dynamo belt, 900 h. p. would be delivered to the line. The line wastes 10 per cent., therefore, the motor at the other end receives 810 h. p. As this passes through the motor 10 per cent. is again consumed in losses that are usual. The balance of 729 h. p. is ready for delivery at the motor pulley. It is thus seen that irrespective of the distance, if the efficiency of motor and dynamo be 90 per cent. and loss in line 10 per cent., the amount of power delivered is 72.9 per cent. of that originally supplied. Lord Kelvin has defined the limit to the expense of building a line. It is not the best thing to build it of the heaviest copper, as the expense over a long distance would be very great; it is not advisable to have it too small in size, as the power lost in it would be too considerable. Thomson's statement takes the following shape:

"Build the line of such a size that the interest on the money invested equals the cost of the power wasted per annum." The happy average is thus set forth and specifically determined.

A problem at times arising into prominence is the feasibility of transmitting surplus power from America to England. The vast coal-fields of this country and its water-power may in the future make it the central market of power of the globe. A cable would not be sufficient for this purpose in its present condition. The insulation would not stand the strain, and the probable loss would exceed our expectations. It is not unlikely, however, that the power of Niagara could be sent across the ocean and used to drive the machinery of England's most thrifty towns. There are no difficulties in the way, and all questions affecting the project are those which would determine, not the possibility, but the most economical conditions.

THE COMMERCIAL VALUE OF ACETYLENE GAS AS AN ILLUMINANT.

BY LOUIS A. FERGUSON.

(*Continued from page 255.*)

THE gas is then drawn from above the carbide, and as long as it is being used the water remains more or less in contact with the carbide, but as soon as the consumption of gas ceases or diminishes, the pressure of the gas forces the water downward into the lower part of the vessel and away from the carbide, thus causing the generation of the gas to cease. An arrangement similar to this is one proposed for country residences.

Acetylene gas may also be used in its liquid form, and is prepared by decomposing the calcium carbide with water in a closed vessel and conducting the generated gas under pressure to a condenser, where it liquefies and is then drawn off in tanks for shipment and distribution.

Compared with other gases acetylene has a very high candle-power. Water gas, which is used in nearly all the large cities of the United States for illuminating gas, when burned at the rate of five cubic feet per hour gives from 20 to 25 candle-power, while acetylene when burned at the rate of five cubic feet per hour gives according to most observers 240 candle-power, or approximately ten times the illumination of water gas.

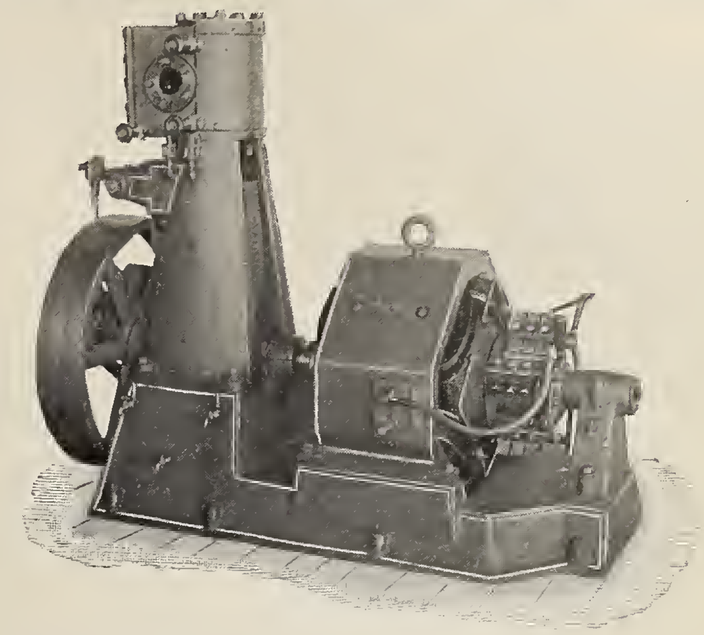
The temperature of the acetylene flame is low as compared with that of water and coal gas, Prof. Lewis placing the temperature of the acetylene flame at 1,000 degrees C, and the coal-gas flame at 1,360 degrees C. It has been stated by Prof. Crafts, of the Massachusetts Institute of Technology, that the true relation of the temperature of the present commercial illuminants when giving the same candle-power is: Incandescent light one, acetylene three, and water-gas nine, showing that the incandescent lamp gives off the least amount of heat per candle-power, while acetylene gives three times that of the incandescent lamp and one-third that of water gas.

Many experiments have been made by noted scientists and investigators to determine the poisonous qualities of acetylene gas. Guinea pigs, dogs and other small animals have been made martyrs to science and subjected to mixtures containing carbonic oxide, which is the poisonous constituent of ordinary illuminating gas, and after their death their blood has been examined and the amount of carbonic oxide absorbed by the blood determined. Grehant made comparisons of carbonic oxide and acetylene, to determine their relative poisonous qualities upon dogs. In his experiments he used 20 per cent. of oxygen in his mixtures, so as to prevent the animals' death by suffocation. He added enough Paris illuminating gas, which contains seven per cent. carbonic oxide, so as to give one per cent. carbonic oxide in the mixture. The dog showed signs of suffering after three minutes, and in ten minutes the dog was very sick, and his blood showed 27 volumes in 100 of carbonic oxide. Another dog was subjected to a mixture containing 20 per cent. oxygen and 20 per cent. acetylene, and the dog breathed withont inconvenience for 35 minutes. Upon examination his blood showed 10 per cent. acetylene, less than 1/50 the rate of absorption of carbonic oxide. The mixture contained much more acetylene than that to which a person could be subjected in the use of acetylene as an illuminant, since a leak of the gas would produce an explosion in the room of a dwelling-house before the percentage of acetylene mentioned were attained in the atmosphere.

(*To be Continued*).

Burhorn & Granger, of 136 Liberty street, are contracting mechanical engineers. They are the New York selling agents for the Stearns Manufacturing Co. of Erie, Pa. This company manufactures the Woodbury high-speed automatic engine, and also the Shepherd vertical high-speed automatic engine. Both engines are made in Erie, Pa. The Woodbury engine on exhibition is 9 x 12, of 46 h. p., and 300 revolutions per minute. It is direct-connected to a 25-K. W. Fort Wayne direct current generator. The engine is running arc and incandescent lamps on the main floor. At no time is the load on the dynamo less than 100 amperes. It is not bolted to any foundation, but leveled by wedges. Under these conditions they can balance coins on the guides and cylinder heads. Very interesting tests were made, showing the regulation by means of a tacometer, which instantly showed any variation in speed; and by throwing all the load off and on, the variation did not exceed two revolutions. Within a second after, the engine took up its regular speed. The perfect regulation was such that the coins placed on different parts of the engine maintained their positions without a change. There is no doubt but that the engine is perfectly balanced in every part. The governor is so constructed that a state of equilibrium always exists; it is, in addition, almost frictionless. The valve is balanced likewise and answers every condition of ideal construction.

Messrs. Burhorn & Granger will guarantee to furnish these engines in combination with any first-class generator for elevator use or for power and lighting. The voltage is evenly maintained to a degree satisfactory to the worst critic. Their compound engines are pieces of fine engineering. Their finish and capacity for continued work and unequalled power of regulation have brought them foremost in the minds of all that have used them.



SHEPHERD ENGINE—EDDY DYNAMO.

The vertical engine at the Exposition is 6 x 6, and of 18 h. p. It runs at 500 revolutions per minute, and is direct-connected to an eddy generator. This engine has the same governor and practically the same regulation. The engine is perfectly balanced; this can be shown by placing the hand on the engine while running. The vibration is not noticeable, although the engine runs at a high speed. Its consumption of steam is very small and its economy great. A plant of this description, with dynamo direct-connected, was installed in the metropolitan apartment houses at Eighty-eighth street, New York.

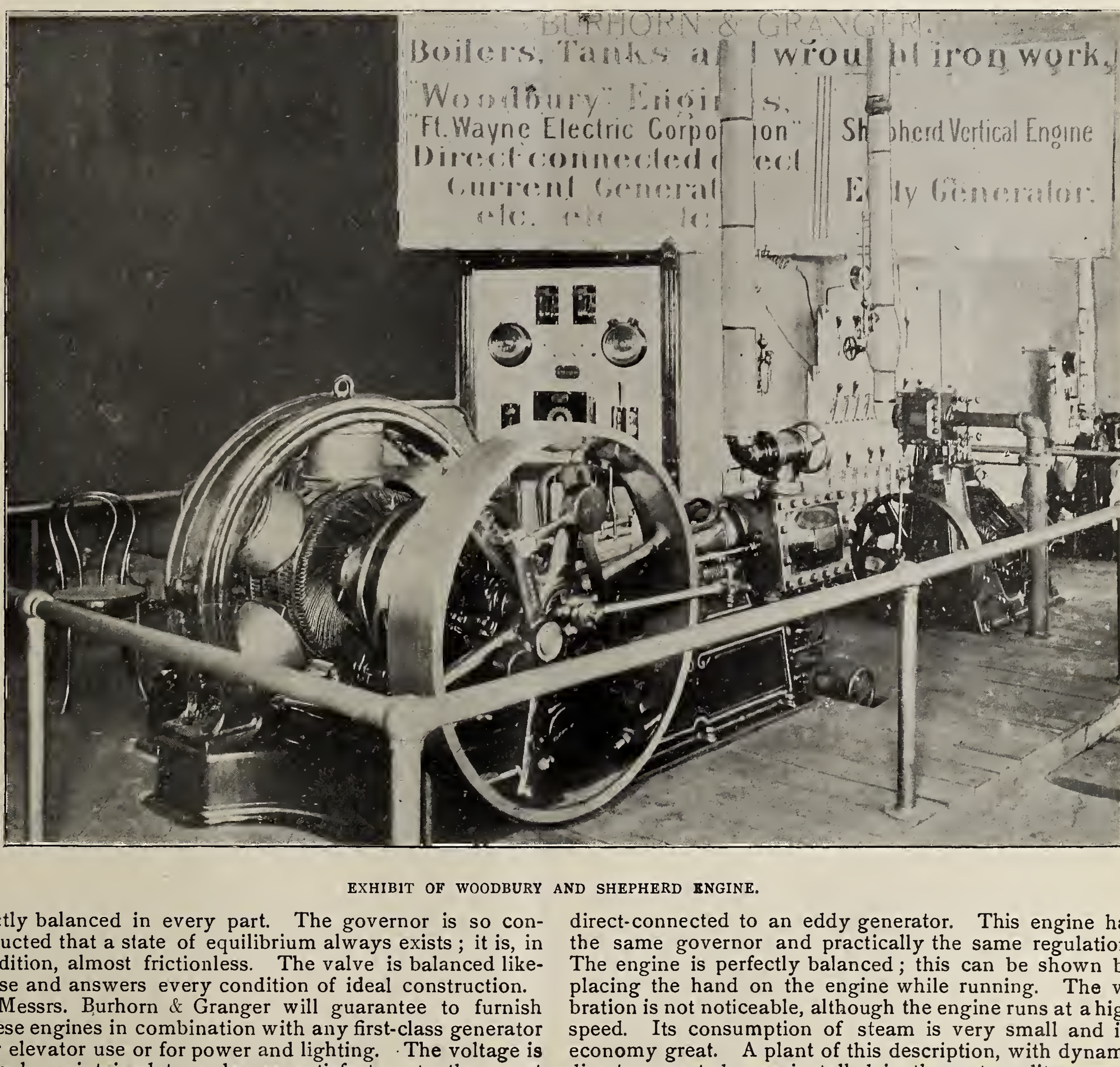


EXHIBIT OF WOODBURY AND SHEPHERD ENGINE.

EQUALIZER SYSTEMS OF DISTRIBUTION.

BY A. CHURCHWARD.

(*Continued from page 264*)

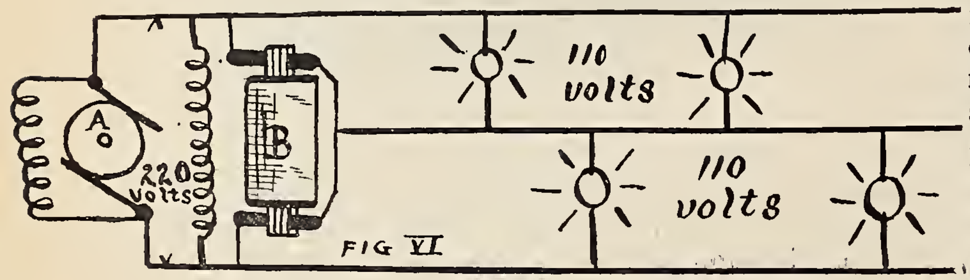
WE have only two bearings to worry about.

Only one field loss.

One loss due to hysteresis and eddy currents.

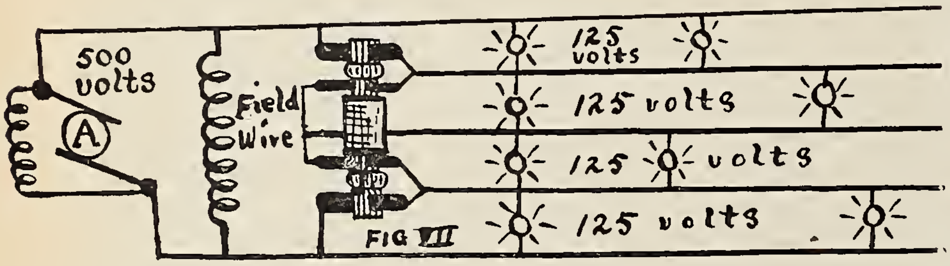
And absolutely no armature reaction.

There being no armature reaction, there will be no drop in speed, no sparking at the brushes with a change of load, and the capacity of the equalizer will be the heat limit of the armature winding.



By using the equalizer system we have one unit, or set of units, running at a high efficiency, and for a reserve we have only one machine.

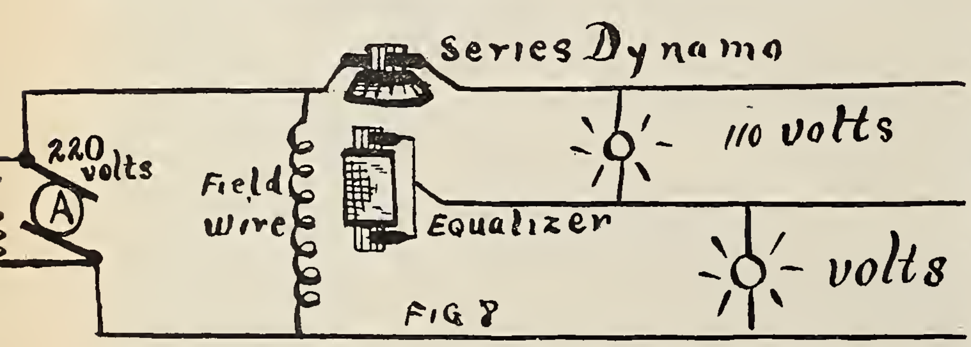
It is not limited to only 220 volts. Where a company has a motor trade much scattered they can take, for instance, 500 volts and run a good distance with economy;



then put an equalizer in a central location and supply your customers with lights at 110 to 125 volts.

Or, again, we want light and power in one unit.

We can take one generator 50 k. w., 250 volts, and a motor of 50 h. p., but with two commutators; or, in other words, on a 50 h. p. equalizer we can take either the full



load in power off the pulley or the full number of lights off one side at 110–125 volts, or in any proportion we see fit.

Still another advantage of this system—we can always compensate for the drop in our line at any point independent of all others.

This we might call a booster equalizer system.

When the heaviest loads are on our system and the sides balanced, all the equalizer does is to run free as a motor. Now, by attaching a small series wound dynamo to the end of the shaft of the equalizer, and adjusting it to the load and drop, we will first boost our pressure and then equalize it. So that, given a district with various points of distribution and various drops, we can run over the longest and heaviest loaded circuit at the same pressure as our station e. m. f.

(*To be Continued.*)

Interesting Facts in Science.

To the North Pole in a Balloon.—When S. A. Andree and his friends sail for the north pole it will not be in a common ship, but in a fine balloon which the daring Franco-Swede has been busy constructing for several months past. The start is to be made at the Norsk Islands, Spitzbergen, and the aeronaut calculates that if the wind is favorable he will be able to cross the pole in about ten hours after leaving Spitzbergen. But if the wind is only moderate Herr Andree claims that he will be able to reach the pole in less than forty-eight hours. The distance from Spitzbergen to Bering Straits, it is thought, ought not to take more than five days in all, but the expedition has been allowed thirty days in case of accident. The balloon has been especially constructed for the perilous trip and with a view to the peculiar meteorological conditions it will be focred to pass through. The top of it is covered with a cap of cloth soaked in oil, the idea being that the thin-air reservoir which is placed between the cap and the balloon shall act as a guard against any sudden changes in temperature, and also that no snow shall rest on the top of the balloon. There is no valve on the top, but the balloon is provided with two valves at slightly different heights near the widest part. The diameter of the balloon is about sixty-seven feet, and it holds 135,000 cubic feet of gas. The covering is of cloth, treble varnished. The car for the passengers is made of cork, with a roof, and contains sleeping places for two. The balloon is furnished with a sail about 888 square feet, the object of which is not only to form a steering apparatus, but also to accelerate the speed of the balloon. Above the passenger car is another for carrying provisions and supplies necessary for emergencies. The balloon will carry 4,620 pounds of ballast, for four and one half months, various articles of clothing, guns, sufficient ammunition for 1,500 charges, scientific and photographic instruments and a cooking stove. Aeronaut Endree is sure of success in his perilous trip.

Temperature of Incandescent Filaments.—Professor Weber has lately given the results of a number of experiments made by him to determine the temperatures of filaments in electric incandescent lamps. He has found that the normal temperatures of all species of incandescent lamps is approximately the same, and is comprised between 1,565 and 1,588 degrees centigrade. In the case of some lamps giving a very brilliant light, that is to say, with very thick filaments, the temperature is 40 degrees higher.

Electric Dredging Machinery.—The well-known firm of A. F. Smulders, of Slikörveer, Rotterdam, have made encouraging experiments with an electric dredging plant. The plant has, according to the "Schweizerische Bauzeitung," been ordered by Mr. Bunau-Varilla, formerly engaged on the Panama Canal, for the Elsa River, in Spain. The electric machinery was supplied by Messrs. Brown, Boveri & Co., of Baden. The power is produced on shore, where a 150 h. p. engine is driving a three-phase generator whose currents of 2,000v. are sent over to the dredger by a cable. On board the currents are converted down to 200v. to drive the various electric motors. The obvious advantage of the arrangement is that the power plant on board becomes much simpler, that less men are required, and that the chaining of the dredger becomes easier than when a pipe connection has to be maintained between the dredger and shore. Whether the electric motor is fitted for the exceedingly rough work is a different question, which would, however, only be a temporary bar. Electric centrifugal apparatus have for some time been working on the Continent; they had to be specially constructed, but they perform their duty. In this case five 10 h. p. motors, three 25 h. p. and one 15 h. p. three-phase motors are applied.

The very interesting three-phase plant in the sugar refinery of Messrs. Scheringer, of Uerdingen, was described by Mr, Pfankuch, before the February meeting of Iron Producers, at Düsseldorp.—*Trade Journal Review.*

THE EVOLUTION OF THE ARC LAMP.

L. H. ROGERS.

(*Continued from page 264.*)

THE ARC LAMP MUST MEET THE DEMAND.

REMEMBER that the title of this paper is The *Evolution* of the Arc Lamp, and that evolution denotes a continuous development. Since Brush perfected the fundamental principles of the commercial arc lamp, what has been done? In 1875 the arc lamp was a great ball of wonderment. In 1878 to 1880 a few were induced to really try them practically. During the next decade, the mad lighting fever was in full sway, and two hundred and fifty thousand arc lamps had been hung up in the United States by 1890. The manufacturing companies were too busy shipping and collecting to think of anything but of something which would burn. The lighting companies were too busy making contracts with municipalities and supplying the demand for light to ever look to see what was inside the lamp.

But this is the age of close inspection. Municipalities are not paying $350.00 per year for a 2,000 C. P. arc lamp in 1896. They encourage other companies entering their city limits, and this brings keen and active competition. If competition is not encouraged, or if prices for lighting are not reduced, the "tax-payer"—that tireless individual who never dies—is heard from, and starts the agitation for a municipal plant on the theory of his *new* discovery that electricity costs nothing to "make."

It is not the purpose here to discuss this swing of the pendulum from too high prices—it has, indeed, swung too far already in the other direction—but it does behoove us to examine closely into the daily expenses and annoyances to which the electric lighting plant is subjected.

There is no business which has developed so rapidly and so radically as that of electric lighting. The frame building, 20 feet square, has been replaced by a handsome brick and iron-roofed structure 150 x 300 feet, and three stories high. The deliberate saw-mill engine, at 90 revolutions, has been replaced, first, by the diminutive busy little high speed engine at 350 revolutions; then by a larger type of the slow speed engine, and, later, by a compound condensing engine at a piston speed of 800 feet per minute. The transmitting devices have been changed from belt to rope and rope to direct. The boilers have undergone a radical change, and the manufacturer must now guarantee the pounds of water evaporated, per pound of coal, by his make. Remarkable and needed improvements have been made in the dynamo, as we have mentioned. The efficiency has been raised from 50 to 85 or 90 per cent. A 125-light machine is less trouble and care to run than an old 10 lighter.

In all this development, in this search for high efficiencies, in this attempt to get running expenses down to the minimum,

THE ARC LAMP HAS BEEN OVERLOOKED.

The most important single piece of mechanism in the entire system, it has been the last to receive serious attention.

There are 2,711 central lighting stations in the United States, with $320,000,000 invested. The sole and only object of this outlay is to get *light*. The engines, dynamos, belting, conduits, buildings are all secondary to the arc lamp. It is the exponent of the entire problem. It is literally in the "eye of the public" day and night. Its lines of—(I was about to say beauty, but whoever heard of a beautiful arc lamp?) At any rate, it stands against the morning sky or the evening sunset; and, in truth, I hear the public say: "It must be the best the electricians can do, for I have watched for fifteen years, but have seen no change; they are all alike in their hideousness."

And now let us look at the subject squarely. Let us hold the arc lamp up between the flourescent screen and the Crookes tube, and in the light of X ray 1896 knowledge examine the arc lamp hanging in our streets.

We find a device 50 to 60 inches long, made of long tubes or chimneys, a sheet-iron drum, long side rods, and at the bottom a globe-holder.

(*To be Continued.*)

ROENTGEN RAYS.

Bodies have no Color of their Own.—Bodies have no color of their own; the color of the body changes with the nature of the incident light. Thus, if a white body in a dark room be successively illuminated by each of the colors of the spectrum it has no special color, but appears red, orange, green, etc., according to the position in which it is placed. If homogeneous light falls upon a body it appears brighter in the color of this light if it does not absorb this color, but black if it does absorb it. In the light of lamps and of candles, which from the want of blue rays appear yellow, yellow and white appear the same, and blue seems like green. In bright twilight or in moonshine the light of gas has a reddish tint.

What is a Current.—An electric current, according to Maxwell, is a flow or progression of electric particles which are free to move forward in a conductor, and which can move steadily forward owing to their incompressibility when the circuit in which they flow is a complete circuit.

A Thousand Million Oscillations per Second.—A small condenser can be made having an electrostatic capacity of, say, two or three centimeters, and if such a coated pane be made to discharge over its edge, the discharge circuit will have an electromagnetic inductance of a few centimeters. Under these circumstances the electrical oscillation would be at the rate of a thousand millions a second, and the wave length of the electromagnetic disturbance radiated would be about 20 to 80 centimeters.

Coloring Matters by Electrolysis.—Some of the coloring matters hitherto produced only by strictly chemical processes can also be manufactured by electrolytic processes; and it seems likely that the near future will see a very large number of such substances being made by electro-chemical means. A few months ago it was discovered that certain orange coloring matters can be obtained by electricity, and it seems they are being made on a commercial scale at Basle, in Switzerland. The *Electrical Review* says that by reducing the yellow alkaline condensation products of p-nitrotoluene sulphonic acid in an alkaline solution by means of the electric current, the yellow coloring matters are converted into orange dyestuffs. A mercury cathode is preferably employed, as the production then proceeds at a lower temperature. The best strength of current is 5–15 amperes per square decimetre of cathode area. About 10 kilos. of p-nitrotoluene sodium sulphonate are condensed in the usual manner in an aqueous solution with 30 kilos. of soda lye of 30°B. After dilution with 70 litres of water, the whole is reduced at 45° C. in an electrolytic cell with a mercury cathode until a sample on paper shows a spot free from yellow. The solution is then neutralized, and the dyestuff salted out. When filtered and dried, it assumes the form of a dark-brown powder, easily soluble in water. It has a yellowish-red color, and assumes a dark violet-blue color in concentrated sulphuric acid. It dyes unmordanted cotton orange from a neutral or alkaline bath fast to air, chlorine and acids. If this new process stands the test of time, and succeeds in producing dyes which possess as good qualities as the same substance manufactured by chemical processes, and at the same time possess commercial advantages, we may anticipate that a new and important field will be opened up which may be usefully exploited by those who complain that the electrical profession is overcrowded.

RECENT DEVELOPMENTS IN VACUUM TUBE LIGHTING.

BY D. MCFARLAN MOORE.

(*Continued from Page 266.*)

D. MCFARLAN MOORE.

BUT this disparity is greatly reduced by the vacuum vibrator. This accounts for the intense light in the tube at comparatively low potential, and indicates that nature's keyboard has been struck to the tune of 500 trillions of waves per second, and that this rate is maintained by the fundamental mechanical vibrations of the vibrator—about 100 per second—a most beautiful demonstration of nature's wonderful compass. But not only is more light produced by the vacuum vibrator than was heretofore obtainable, but there accompanies it many other advantages of particular importance. Three of these can be mentioned:—first, simplicity and greatly reduced cost of apparatus; second, the obviation of impracticable potential, and third, a very marked advance in economical production. The first heading, simplicity, has already been dwelt upon. Compare an inexpensive magnet, not as large as one's hand, and a vibrator the size of one's finger, attached to commercial currents, with apparatus costing thousands of dollars, consisting of a high speed alternating dynamo of many coils, oil transformers, disruptive discharges with magnetic blast, induction coils and condensers. The many seemingly unsurmountable difficulties encountered with this method, are almost completely overcome by the simple expedient of the ether gap. Or, referring to ordinary induction coils, the vacuum break affords a means for obtaining from the few turns of comparatively coarse wire results not obtainable with mammoth and expensive coils, made of many miles of wire, and capable of creating enormous differences of potential.

The second heading is essentially a practical one. It has often been argued, to the detriment of tube lighting, that since it was admitted by its supporters that enormously high potentials were absolutely requisite to cause any appreciable amount of light, that therefore (and the argument was logical) the whole idea was extremely impracticable unless some new insulator be discovered that could cope with the high potentials, so difficult, dangerous and expensive of generation and manipulation as to prohibit their use commercially. But with a current endowed with such properties as are given it by a vacuum tube vibrator, no new insulator is needed.

A light now results many times brighter than that formerly due to millions of volts, able to pierce several inches of hard rubber, or produce a spark many inches in length, from a current transmitted to the bulb or tube over ordinary flexible cord, and whose sparking distance is less than one-sixteenth of an inch. Neither can any shock be felt from such a current. Another example of the comparative ease with which this new current can be insulated is apparent in the magnets, wound in the ordinary manner, in striking contrast with the necessity for expensive and cumbersome oil transformers. In this light the exclusion of all gaseous matter does not seem to be a matter of such vital importance.

Closely allied with the subject of insulation is that of frequency. The higher the frequency, the lower the potential can be, not only with respect to light, but also to insulation, because irregularity in the rate of vibration puts the insulation to a severe test. However, the period of the vibrator is not rapid as compared to that of alternating dynamos, constructed to obtain similar lighting effects, but resulting in those of lesser degree. The alternations of such a machine are about 30,000 per second, which is further increased by a disruptive-discharge coil. This was necessary to compensate for the long wave lengths of the current. But since these lengths are so much shorter in the vacuum vibrator current, an initial frequency one-fifth as great, without the use of additional coils and condensers, produces far better results. But that an ordinarily constructed vibrator can attain a speed of 6,000 per minute may be questioned, when it is remembered that induction coil vibrators work at a rate of but a little over 1,000. The difference lies in the fact that the vacuum vibrator has no air pressure to impede its movements, and also that a much shorter space of time is required for a single complete interruption, because the actual mechanical movement can be much less, yet cause a complete break, and another cycle has begun. The speed of the vibrators is ascertained in two ways:—first, by comparing the musical note it produces with that of a pitch pipe, and secondly, by a visual arrangement constructed and operated as follows:

A shaft, supporting a wheel with one spoke, is rotated rapidly by hand, a series of multiplying gears being used, so that when the hand makes one revolution per second the spoke makes twenty. When this apparatus is operated in a room lighted only by a single vacuum tube, the spoke will appear stationary in one, two or three positions, according to the rate of the vibrator. For example, if the spoke appears stationary in two positions it indicates that it is illuminated twice in a single revolution, each image being due to a vibration.

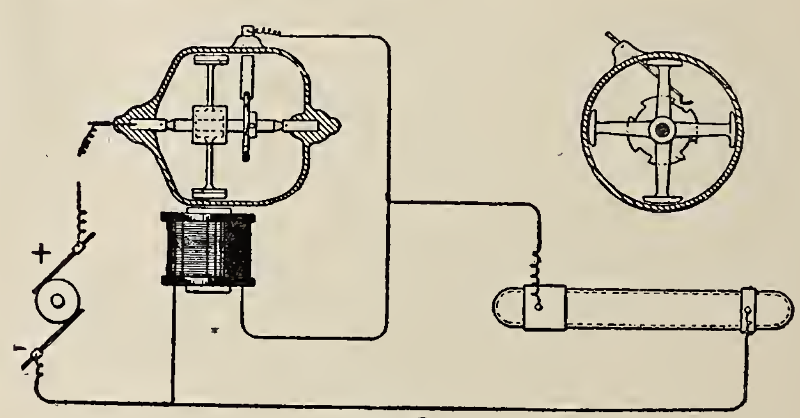


FIG. 31.

Another subject which has been a serious obstacle in former proposed systems is that of impedance. The fact that the best conductors would cease to transmit current seemed a difficulty almost unsurmountable, yet it appears to be almost absent under these new conditions. For example, when a large coil is inserted in the high potential lead from the armature terminal to the tube, the effect on the light is surprisingly small. The result is the same whether the wire be in the form of a magnet or in a long, exposed line. But, nevertheless, on account of line losses, it is advantageous to prevent condenser action by using a wire as small as possible, yet able to stand the strain it is subjected to when its insulation is being placed upon it. Although the light produced by a single wire is quite good, it is decidedly advisable for best results to use a return wire, because the fundamental frequency is so low.

The third subject—economy—is so large and of such importance that I deem it expedient to make it the subject of a future paper when accurate measurements have been made. Indeed, it is second only—but it is second—to the nucleus of the whole investigation, viz., getting light. The efficiency of the lighting tube is well established, due principally to the great amount of light accompanied by so little heat that it has by some been called "cold" light. The temperature of the gas within the tube varies with the density of the discharge from 12 degrees to 132 degrees C.;

(*Continued on page 284.*)

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NEW YORK, MAY 30, 1896.

CONTENTS.

THE INCANDESCENT LAMP OR THE VACUUM TUBE.

An array of lighting methods are before the public a present. The incandescent lamp has not reached tha point of economical excellence expected of it. We canno make the carbon stand a much higher temperature withou seeing its rapid destruction. What then must be done to remove the obstacle to cheap light, to light which does not represent concentrated heat with all its uneconomical characteristics? We have persisted in the past in using a heat method for the production of light. Were the power of an incandescent lamp used at 80 per cent. efficiency, the light obtained would equal 400 candle power.

These figures have been constantly reviewed by competent authorities, yet none have more than expressed their sorrow at the deplorable discrepancy between the power consumed and the light obtained.

Moore, with his practical results, has done much to show that a lighting system can be used for domestic purposes, in which no heat process is required. Vacuum tubes are used which are exposed to a sudden discharge of high potential. He has successfully demonstrated the practicability of his idea. A room, lit as brightly as one would desire, with a strong white light, has been inspected by thousands at the Electrical Exposition. It seems as though there were no impediment to its immediate introduction. The incandescent lamp has surely another competitor in these vacuum tubes. The practical test might now be made in several houses; if successful, why not adopt at once so excellent a means of illumination?

A SYNDICATE FOR THE DEVELOPMENT OF TOWNS.

The limitations imposed upon us by circumstances have always been the means of stimulating inventors and of producing new and ingenious methods. It has been the pet object of many experts to send power over hundreds of miles and receive a reasonable return at the other end. Where power or fuel is cheap, it may just prove sufficient for the surrounding towns; should it be in excess of their needs, however, the wasted power may if possible be guided to a centre where both fuel and power are more expensive, where the inhabitants are handicapped by its absence and where the life of the town depends upon its plentiful distribution. Such problems as these are by no means rare. A company has often been organized for a purpose less creditable and much less useful to the world. Those for instance that have carried expensive machinery to California to crush gold-bearing granite and extract the precious metal. Is there not a greater element of chance in such works than there is in building a power plant where electricity can be generated cheaply and distributed to towns that require it. Gold-bearing granite may fail, the rock may become impoverished and the plant useless.

Not so with power plants. Lack of success can only be due to poor engineering, uneconomical methods and lack of skilled attendance. It must be understood that if the cost of power that has been transmitted is greater than that which can be generated on the spot the scheme will not succeed. The arm of competition will fling away intruders unless their presence is financially inviting. It is thus a matter capable of definite analysis. The development of a town, by power being at its command, has usually followed without delay.

A syndicate for the development of towns might be formed on this basis. Such industries as are being carried on might be hastened in their growth, and those which might prove useful originated without delay. All along New England, some of the Middle Atlantic and Western states transmission plants are being used; the mining districts in Colorado, California and Mexico find them a gracious boon; the South American colonies are enthusiastic about them. The busy wheels of commerce are driven by the power of steam or electricity. All that is best in our present civilization owes its existence to the touch of useful and well guided power.

A syndicate controlled by men of judgment could open up a thousand occupations for the emigrant poor by pursuing a policy that would thus perform a double function; establish a large plant and rebuild a mildewed town.

The revised and *elected* ticket for the New York Electrical Society for 1896–97 is:

President, Dr. C. E. Emery; Vice-presidents: Herbert Laws Webb, Gano S. Dunn, Max Osterberg, A. L. Riker, William Finn, W. W. Kerr; Treasurer, Henry A. Sinclair; Secretary, George H. Guy.

The American Institute of Electrical Engineers has been invited to send a representative to take part in celebrating the jubilee of the professorship of the Right Honorable Lord Kelvin, which will take place in Glasgow, June 15th and 16th.

President Duncan has appointed Past-President Thomas Commersford Martin to represent the Institute on this interesting occasion.

(*Continued from page 282.*)

but even this is improved by the shorter wave lengths. These figures are extremely low as compared with temperatures as high as 3,500 degrees C., which must be reached by some substances in order that the light be white and the spectrum complete.

Owing to the peculiar characteristics of the current the line losses are materially decreased and the current flowing through the primary circuit is less when the tube is giving light than when it is disconnected. There are almost no losses for motive power to disrupt the current, for the magnet is its own motor. But the greatest loss has always been in the disruptive discharge—the spark. It is remarkable how easily several horse-power can be dissipated in the air through the intervention of a disruptive discharge. In this connection it should be borne in mind that magnetic blow-outs and air currents are merely heat dissipaters, and increase the loss, while these losses are entirely obviated by the vacuum vibrator. The current can perform a large amount of work on the air, unlimited in volume, with no apparent results; but when this volume is reduced to the compass of a small vibrator tube which remains perfectly cool in operation, does not the question of efficiency assume a different aspect?

Upon these reasons may be based logical conclusions, pointing to an enormous increase in efficiency over that of all other methods of obtaining light in tubes.

The theory which has just been considered, of course, is not limited to a simple vibrator, but applies broadly to any method of interrupting the flow of current through a high vacuum. This can be accomplished in a great variety of ways, although as far as simplicity of apparatus is concerned the regular spring vibrator, in connection with a single magnet, probably cannot be improved upon.

The first deviation, however, is to use a very small magnet to vibrate the armature and to connect this in series with a larger one to furnish the induction. But in these cases the power of the operating magnet depends on the current passing over the contact points; hence to make the light which is dependent on the contact points perfectly positive, the power should not be dependent upon them, and separate circuits suggest themselves—that is, cause an intermittent current to flow through the power magnet that does not flow through the contact points of the vibrator, which have in circuit with them the inductive magnet. Or the electrodes can be separated by mechanical jarring instead of magnetic power acting through the glass.

If an ordinarily constructed vibrator be attached to any form of rapidly oscillating mechanism, the contacts within will be opened and closed rapidly. But in order that the light be steady, the movements of the vibrator armature must be in step with the movements of its mechanical support. This is best accomplished by having the centre of the oscillation of the vibrating armature coincident with that of its oscillating support.

It is plain that it is unnecessary that the current be interrupted by a reciprocal motion only; a rotary motion is also applicable.

Fig. 31 shows a form somewhat analogous in operation to the simplest vibrator, except that the rotary momentum of the armature takes the place of a spring, and the break-wheel which furnishes the light also acts as a commutator to the simple form of motor.

(*To be Continued.*)

What is Magnetism.—The angular momentum of certain vortices represents the magnetic induction, and hence the mass of each cell, or the density of the medium, is the anologue of the magnetic permeability. This is greater in paramagnetic substances than in air or vacuum, and greatest of all in iron; in fact, so exceptional is it in iron that Maxwell supposed the particles of the iron themselves to take part in the vortex action. Hence the energy of a magnetic field is greater if that field contain iron, and accordingly the presence of iron in a core immensely increases the vortex energy for a given vortex velocity; that is, it increases the inductance of the circuit.

MOTORS, DYNAMOS AND THEIR CLASSIFICATION.

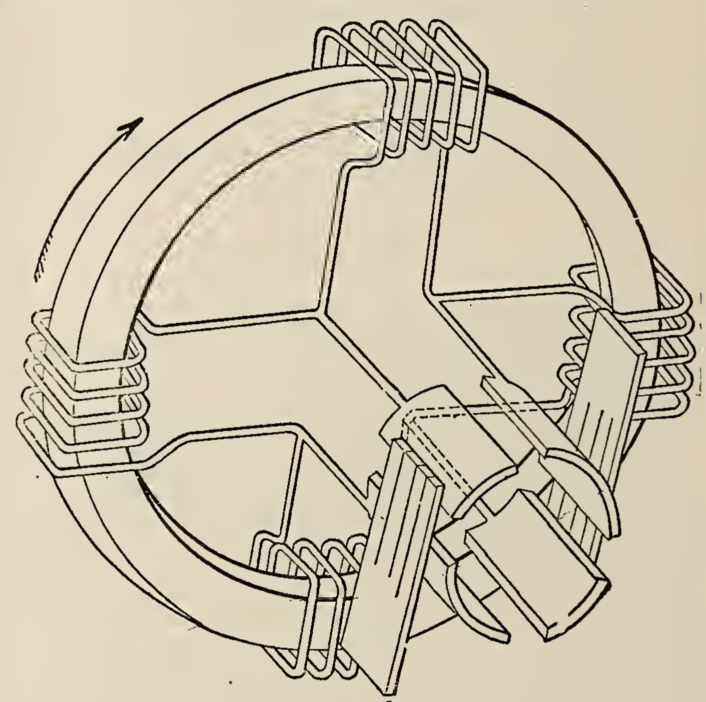
LESSON LEAVES

FOR

THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

If a motor be considered as a machine in which electrical energy is converted into mechanical energy, its convenience and usefulness cannot be misunderstood. There is at present no device of equal efficiency. Its rating is of the highest order and its universal application a matter dependent entirely upon the cost of electricity. There are many types of motors and dynamos on the market whose points of excellence may be critically examined. The general classification of the windings and a division of the magnetic circuits into groups is most instructive to the lay reader.



RING ARMATURE.

Windings.—The dynamo and motor are both made up of two distinctive parts,

Armature,
Field.

Each of these has a distinct function to perform. The armature, by rotation or otherwise, cuts the lines of force and thus creates within its turns an electrical pressure commonly called electromotive force.

In the great majority of dynamos and motors the armature revolves, and thus performs the work it was intended for.

The field is of a different construction from the armature in this respect, that it simply supplies magnetism or lines of force to the armature. The greater the strength of this magnetic field the higher the speed of the armature, and the greater the number of turns on the armature the higher will be the electromotive force (E. M. F.) produced.

The field merits our first attention; it is generally wound in three ways:

Series,
Shunt,
Compound.

Series Winding.—The series winding is one in which the *entire* current from the armature flows around the magnet winding, both being connected in *series* in order to obtain this result. Also, if used as a dynamo, the current which issues from the armature passes through lamps, etc., before it reaches the field.

Therefore, we have a complete series circuit from armature, through outside circuit, through field back again to armature. Arc light machines are series wound and in the

New York, 100 Broadway, May 25, 1896.

Editor The Electrical Age :

In some of the New York papers I recently noticed lengthy articles headed "Tesla's Achievements," which would be amusing were they not misleading.

Stripped of ambiguity they stated Mr. Tesla will, "with the aid of a few more experiments, be able to produce 40 per cent. of light, and his perfected (?) bulb gives ten per cent. of light." We need not concern ourselves with what Mr. Tesla is "going to do," as the outcome of the "few more experiments" is purely speculative !

Five years ago Mr. Tesla announced he would revolutionize the lighting field. The public saw some faint electrical pyrotechnics ; then nothing more was seen or heard. No wonder *The Mail and Express* of May 22, 1896, stated — "There is nothing new in Mr. Tesla's work. His light is the same as he showed to the Society of Electrical Engineers five years ago."

In *The Electrical Engineer*, November 13, 1895, I pointed out the constant tendency of the press to credit Mr. Tesla with the achievements of *other* inventors. No one will begrudge him any credit due for original work actually demonstrated before reliable witnesses ; but the articles I am criticising are misleading, in that they credit to Mr. Tesla *Mr. Moore's* achievements. If Moore is substituted for Tesla the articles will be fairly accurate, if all references to what is "going to be" are omitted.

The absence of filaments in the tubes is mentioned. The fact cannot be disproved that the first tube-lighted room in this world's history was lighted by Mr. Moore's vibrator and vacuum tubes ! Neither Mr. Edison nor Mr. Tesla has *shown* a room lighted by vacuum tubes up to this time ! It was Mr. Moore who first demonstrated commercial, etheric lighting. He lighted a room with his tubes over a year ago, as the signed laboratory register and photographs witness. Long before that he lighted the laboratory with lamps and by them obtained clear photographs, alongside of which the Tesla pictures published in the April, 1895, *Century*, are very obscure. Before the *Century* article appeared I showed Mr. Moore's photographs to prominent electrical engineers.

Mr. Moore *alone* is entitled to the credit of having discovered new, fundamental principles and made them operative. In this credit neither Mr. Edison nor Mr. Tesla is justly entitled to share. Yet the dailies are devoting much space to what is "going to be" and ignoring what *is !* They head articles "Edison and Tesla Rivals," and shut their eyes to the fact that Mr. Moore is the *only one* who has shown a tube-lighted room. They print accounts of what "will be," but Mr. Moore demonstrates nightly what *is*.

The unfounded advertising Mr. Tesla is getting is based upon *The Electrical Review* article of May 20, 1896. That article states the *Review's* representative saw Tesla's tube. Did others see it ? It is proper to inquire.

1st. Was the representative (name not given) a qualified electrical engineer, capable of judging, or merely a non-technical journalist ?

2nd. Who made the test of power said to be consumed ?

3rd. How was the illuminating capacity of the tube measured ?

4th. Was the light diffused for any *length* of time, or evanescent ?

5th. Did the light work on alternating and direct circuits, or only on one of them ?

6th. How much power was used ?

7th. Is the system practical ? It is well known that in Mr. Tesla's experiments (five years ago) such enormous voltages were used as made them absolutely useless for any but laboratory use. Moreover (discarding the factor of danger), the cost of insulation would be ruinous, even if, as was not the case, commercial results had been obtained.

Assuming, however, that all the articles stated was true, why has Mr. Tesla not publicly shown his tube ? Why is he not present at the Electrical Show ? If prevented from coming, why does he not send a representative with the tube ? He never had a better chance than the show affords. As Mr. Edison said, "Moore is showing his light and I will show mine. Let Tesla come along and show his. What counts in the world is the man who produces, not the man who talks."

Against Mr. Tesla's statement of what he is "going to do," the discriminating electrical public will place what Mr. Moore actually *did and is doing !* Mr. Tesla lectured in 1891 and has shown absolutely nothing since. Mr. Moore's record follows :

1891. Mr. Moore claimed he could produce better results than Mr. Tesla showed in his lecture.

1893. Sept. 20th. Mr. Moore read his paper before the American Institute of Electrical Engineers on "A New Method for the Control of Electric Energy." Discussion followed and the paper was printed in the Institute's Transactions.

1894. April 1, Mr. Moore showed fine photographs from unretouched negatives, taken by his lamps.

1894. July, Mr. Moore's article on "The Light of the Future" appeared in Cassier's Magazine, nine months ahead of the Tesla (Century) article.

1895. Mr. Moore lighted a room in his laboratory

May, with vacuum tubes, for the first time in history!

1895. Dec., Mr. Moore was photographed by his tubes and a full page reproduction appeared in *The Electrical Engineer*, New York, *The Electrical Review*, London, and elsewhere.

1896. Apr. 22d, Mr. Moore lectured before the American Institute of Electrical Engineers on "Recent Developments in Vacuum Tube Lighting," and showed many forms of lamps and tubes, closing by lighting the hall with 27 vacuum tubes! The photograph of the hall taken by these tubes, after a five-minute exposure, from an unretouched negative, appeared in *The Electrical Engineer*" on May 6, 1896.

1896. May 4th, Mr. Moore lighted up Governor Morton by a frame of 7 ft. 6 inch tubes as he opened the Electrical Show, and showed the signs "N. E. L. A." and "Let There be Light" above Governor Morton's head.

1896. May 6th, Mr. Moore lectured under the auspices of the National Electric Light Association (President Wilmerding, presiding), and lighted the stage with his vacuum tubes. The president held a 10-foot tube showing induction effects.

1896. May 16th, Mr. Moore lighted his tubes in the form of flying arrows and kept them lighted, while Dr. Depew made his speech.

1896. May 20th, Mr. Moore participated in the American Institute of Electrical Engineers' discussion of his paper and by exhibiting his apparatus and tubes more than proved his claims. He scored a great victory and the parties who, before making the tests, had denied his claims, admitted Mr. Moore was right and they were wrong.

1896. May 4th, and every week night to date. Mr. Moore's Chamber of Light has been visited by thousands who have seen and wondered at his artificial daylight. They make an unimpeachable crowd of witnesses to the great simplicity and inexpensiveness of his apparatus and its low voltage.

Is it not singular (to say the least) that only *after* Mr. Moore had made this unimpeachable record did newspaper articles appear stating what Messrs. Edison and Tesla were "going to do?"

Yet many of the dailies are silent about Mr. Moore, and even the lecture he delivered at the request of The National Electric Light Association was referred to by one of the electrical journals only, although the hall was filled with a thousand delegates and others.

Mr. Moore's demonstrations have greater historic value than press effusions, and these demonstrations can not be ignored.

Mr. Moore is most willing to continue his public demonstrations after the electrical show closes. Will Mr. Tesla show his tubes at the same time? Let instruments be used by competent electrical experts. Then let the results of the competitive tests be published authoritatively. The public will always prefer actual achievements to speculative theories.

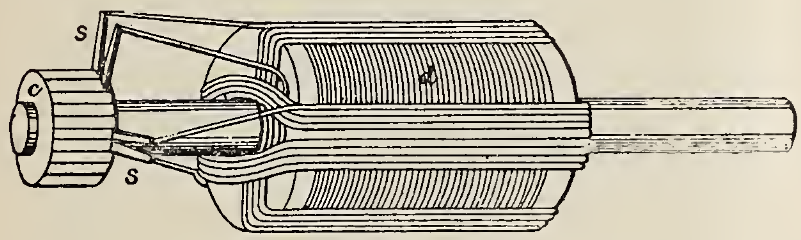
The Goebel litigation showed conclusively the unwisdom of allowing incorrect statements to go unrefuted when made. This is one of my reasons for showing wherein the press has erred. If added argument be needed to demonstrate that Mr. Moore was absolutely the *first* in the vacuum tube lighting field (ahead of Messrs. Edison and Tesla), it will be found in the fact that he secured in the last three years some twenty patents for his inventions in the vacuum tube lighting line, and, further, that a number of his applications are at present awaiting action in the Patent Office. At no time were there any "references" to Edison or Tesla. Patents were only issued after Mr. Moore had gone to Washington, set up a miniature laboratory in the United States Patent Office and proved to the Examiners that they were wrong when they originally wrote "each of the claims therefore must be denied on the ground of inoperativeness." Although the Examiners said his system would not work by any known law, Mr. Moore proved that it *did* work, came off a victor at all points and received his patents.

The editor of *The Electrical Review* saw Mr. Moore's laboratory lighted by vacuum tubes in '94 and was photographed at that time by the light of Mr. Moore's tubes. On the day the *Review* published the Tesla article, Mr. Moore appeared before the American Institute of Electrical Engineers and submitted his apparatus for tests. The result of the tests made by such men as Prof. W. A. Anthony, Prof. Nichols, of Cornell, Nelson W. Perry and others, proved that Mr. Moore in the discussion had understated, rather than overstated, his claims. Let Mr. Tesla produce his tubes, face the same search-light, and if he passes muster, he will get all the credit really due him. No matter what Mr. Edison, Mr. Tesla or anyone else *may* produce, the fact remains that to *D. MacFarlan Moore alone* belongs the credit of *first* having produced commercial light by means of vacuum tubes! It is largely to put this fact indisputably on record that I have written this letter.

EDWARD J. WESSELS,
President Moore Electrical Company.

Thomson-Houston, Brush, Excelsior and Wood dynamos this winding is characteristic.

Shunt Winding.—This type of winding, as its name implies, is in shunt or multiple with the terminals of the dynamo. The field magnets are wound with a size of wire whose resistance prevents it from taking more than enough current to provide the magnetic field required. The current from the armature splits up into two parts. One portion, which is the greatest, supplies the outside lines with current. The other portion is taken away by the magnet winding. The amount required for this purpose varies in dynamos of different sizes from forty per cent. to two per cent.

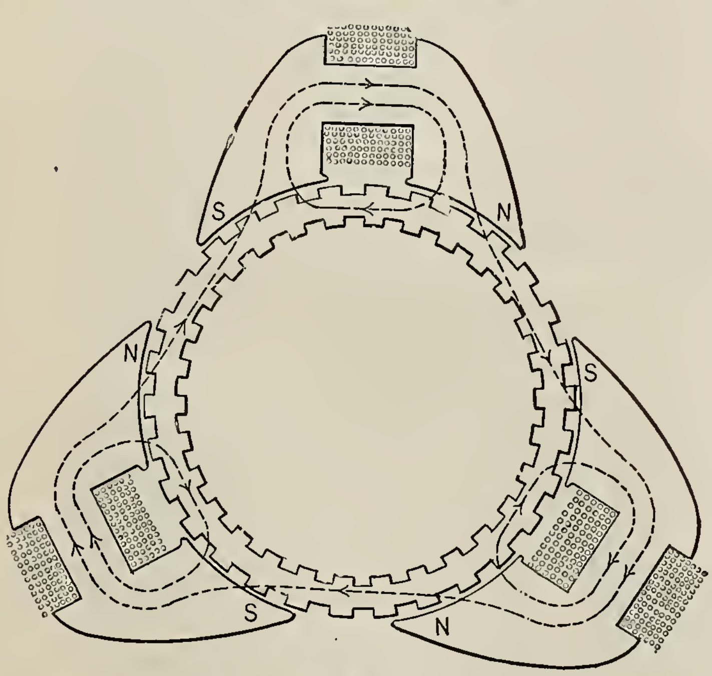


DRUM ARMATURE.

Nearly all continuous current incandescent light machines are shunt wound. Such types as the Edison or General Electric dynamo, the Eddy, Walker, Card, etc. This reference applies only to the magnet, or, as it is generally called, the field winding. The greater number of coutinuous current motors are shunt wound.

Compound Winding.—To obviate certain difficulties in incandescent lighting, such as armature reaction, loss of pressure in the armature and loss of pressure in the lines; a winding partaking of the nature of both series and shunt, called compound winding, has been adopted. Its inventor, Brush, was the founder of a great arc light system. In a dynamo the field winding may be to a certain extent neutralized, due to the fact that the armature carrying current also acts as an electromagnet.

It sends its magnetic lines oppositely to those produced in the field, and thus reduces the effective or resultant field more and more with each increase of current.



MULTIPOLAR FRAME.

The current proceeding from the armature is made to regulate the machine in a very ingenious manner. The coil effects just described may be compensated for by a device which will strengthen the field to the same extent that the armature tends to reduce it; and it may be further strengthened so that the volts lost in the armature and line will be generated in addition, as needed. To effect this result the ordinary shunt winding is first applied; then a series winding is placed beside or on top of this. The series winding has passing through it the entire current of the machine, practically speaking. If this increases when more lamps are applied to the dynamo, the current in the series coil increases; that is to say, its magnetic effect or ampere-turns increases. If the magnetism supplied by these ampere-turns exactly equals that which the armatures neutralize, the machine is compounded for armature reaction. If it supplies sufficient extra magnetism to make up for that lost in the armature and line besides, it is entirely compounded and the dynamo will act automatically with all loads. The drop in the armature, it must be observed, is measured by the product of the current and resistance.

Current $\times$ resistance = drop.

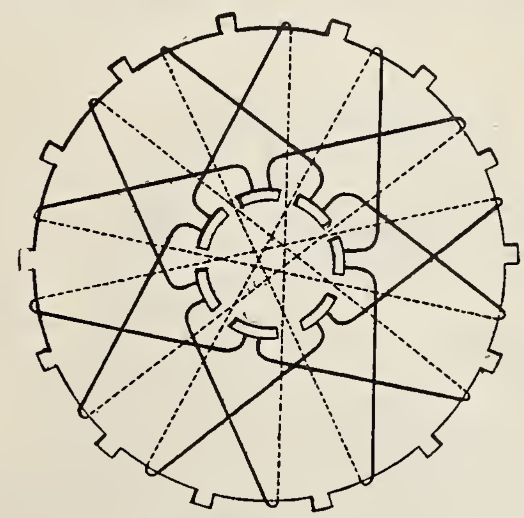
If the armature has Resistance = .1 ohm,
Current = 100 amperes.

Lost volts in armature = .1 $\times$ 100 = 10 volts.

These calculations apply likewise to the line. If the line resistance = .002 ohms,
current = 100 amperes.

Lost volts in line = .002 $\times$ 100 = 2 volts.

The field may be cut down by armature reaction 10 per cent. when the armature is carrying 100 amperes; if 110



DRUM WINDING.

volts are to be generated, there would be a total loss as follows:

Due to armature reaction,	11	volts,
" " drop,	10	"
" line "	2	"
Total,	23	volts.

As a rough estimate the compound winding would be called upon to compensate for this loss which, as noted above, equals 23 volts.

Types of Dynamos.—The shapes of dynamos and motors are classified under two general headings. The number of magnetic circuits determines this:

Single magnetic circuits,
Multiple " "

These may be expressed by the names:

Bipolar or two-poled dynamos,
Multipolar or many-poled dynamos.

Multipolar dynamos have poles in pairs, in multiples of two. They are being extensively used at present in all large stations and in many large isolated plants. The arrangement of the poles to complete the magnetic circuit gives use to many curious shapes.

The ironclad dynamo, with its poles entirely inside, the ordinary horseshoe pattern resting on its keeper or on its poles, and the consequent pole types in which two magnetic circuits feed into one pole, are very interesting to the student. While it is a matter of opinion in many cases as to which is the best, they must be examined from a mechanical as well as an electrical standpoint to appreciate the benefits of each.

Monston, N. W. T.—The organization of the Monston Street Railway, Heat and Power Company was called for the 3d inst.

PRINCIPLES OF DYNAMO DESIGN.

BY

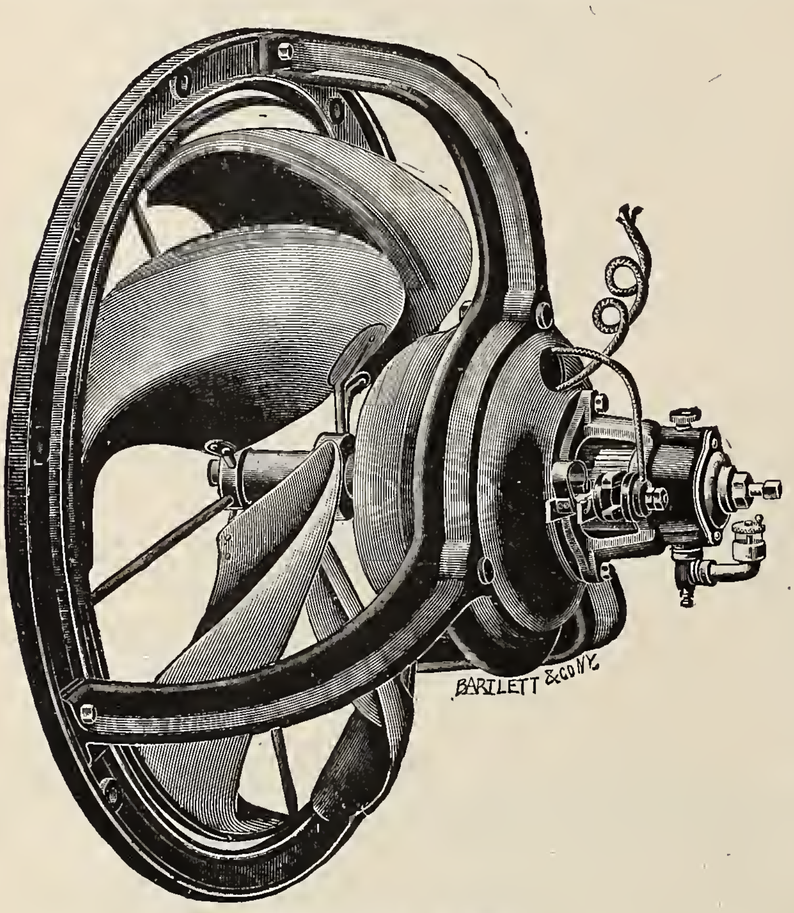
Newton Harrison E.E.

(*Continued from page 270.*)

The difference, therefore, between the applied E. M. F. and the back E. M. F. is 40 volts; the back E, M. F. is therefore equal to $110-40=70$ volts. The electrical efficiency $=\frac{70}{110}=63\frac{7}{11}$ per cent.

This has been referred to for the purpose of showing how easily calculations regarding the inner action of a motor can be made.

The latest use to which a motor has been put is that of running horseless carriages. The storage batteries are held beneath the seat and the motor geared to the inside of the wheel. They are becoming a most popular form of vehicle and will cause great activity in those branches of motor design devoted entirely to specialties.



VENTILATING OUTFIT.

There is still another field for the enterprising engineer to explore—it is the design of a dynamo to suit the conditions of train motion. Trains do not run at a constant speed, they can hardly rely upon one source of power, as in such a case the switching of a train would plunge it into darkness. Storage batteries could be used on each car, but would require a somewhat complex system to keep in order. A dynamo would be very acceptable for such a purpose if it could keep up its potential with a varying speed. To meet such conditions the field, turns and speed would have to be carefully considered. The turns on the dynamo are constant; the field and speed are therefore capable of change.

If the speed decreases the field must increase or the converse. It is therefore only possible to use a dynamo with a quickly acting field. It must furthermore generate at a comparatively low speed; for instance, when the car is slowing up. A cut-out device may be used if the speed becomes too low and storage batteries used to bridge over delays. The field would have to be commutated and coils cut in or out, or the magnets placed in series with a resistance box whose changes would affect the field as required.

The problem can therefore be solved by these two methods. Possibly a device for varying the turns on the armature could be used likewise; that is to say, a means of throwing in or out a series of turns on the armature, which are wound uniformly around it. An armature built on this principle would have four or six distinct windings, which can be thrown in or out of series. Each winding could have a separate commutator and the brush terminals connecting to same controlled by a sliding lever arm. At high speed one or two of the windings are cut out; at low speed all are in series. A certain minimum speed would cause excitation of the field; below this speed a cut-out acts and prevents the battery current from flowing into the dynamo on account of its diminished pressure.

These devices, which apply to such peculiar cases, are coming into prominence. In addition to the above a great variety of fan motor outfits are on the market. They are of every shape and form, and vary in size from one-sixteenth horse-power to one-sixth horse-power. The usual sizes are those built to run an eight inch, twelve inch and sixteen inch fan. These require respectively one-sixteenth horse-power, one-eighth horse-power and one-quarter horse-power. Very often a fan motor will heat severely when used; this is due to the bending of the blades by some perspiring individual in many cases. A great many battery outfits are on the market for summer use. Their main difficulty is the inconvenience of renewing the charge. A fan motor that runs about 1,400 revolutions per minute is about right with a well-pitched fan. A gramme armature has proven an excellent device for fans and is used by some leading makers.

(*To be Continued.*)

SINGLE-PHASE SELF-STARTING SYNCHRONOUS MOTORS.

BY F. H. LEONARD, JR.

(*Continued from page 264.*)

The bearings are of bronze, self-aligning and self-oiling; two small rings travelling in recesses in the boxes so that they can touch the top of the shaft, the rotation of which carries the rings around, lifting, as they turn, enough oil from the chamber below the bearings to keep the shaft abundantly lubricated. As the oil is used over and over again, a single filling furnishes lubrication for months; and as the oil gets low, the rattling of the rings serves as a warning that the oil should be replenished.

The field crown is of the multipolar type, with field cores pointing inwardly; the magnetic circuit is composed of sectional sheet-iron punchings, each section including two poles, stacked so as to break joints. These punchings interlock and are clamped betwen two cast-iron rings with bolts passing through from side to side, which serve to clamp the whole together solidly, at the same time holding each punching in its proper place and tying them like links in an endless chain. The bottoms of the cast-iron rings are milled to fit the base of the motor, to which they are firmly bolted.

On top of the field crown is placed a starting switch, and all the electrical connections from fields, commutator and collector brushes are brought around the outside of the field punchings to the top, concealed from view, however, by the perforated-steel jacket, which is held in place by grooves in the cast-iron clamping rings, forming an ornamental finish and greatly increasing the radiating surface.

The binding-posts for the motor are located at the centre line of the switch. Any inside-wire man who has connected incandescent lamps, will have no difficulty in wiring and connecting one of these motors, as the work is precisely the same as for a two-wire lighting service. The primary wires are connected through a primary-fuse box

(*Continued on page 271.*)

THE GLOBE IRONCLAD MOTOR.

People that buy electric fans seem to forget at times that a name is not a thing. All electric fans are not as

THE GLOBE IRONCLAD MOTOR.

good as one another. If they were there would be no use discussing the pros and cons. Because some are better than others and because one is better than the rest we are inclined to say something about this particular one. What guidance can be given to purchasers of fan motors so that they will feel secure when the money has been invested, not only that it is well invested but that the article they possess is the best. To know we have bought the best is a great satisfaction. How can we know this? A few words will explain how. If a motor, like a good horse or a fine yacht, has certain strong points we can depend upon it; it is not going to deceive us on trial. A fan motor is usually bought to run a few years at least. Some manufacturers do not consider this fact; they rotate a fan which gives a breeze; then their duty is at an end. Very often their business too. The word business means future; it means people's confidence. To secure both you must supply a good article. Those that continue to do this at a fair price get the trade. They last. The others go to the wall—and their fans?—well, they are soon taken off it.

A breeze around an office is a good thing if it is not too strong. When the fan stops working the breeze is apt to begin. This is not the kind that is either healthiest or best. There is another that is better.

The Globe ironclad fan motor is on the market for sale. People that have had any experience with fans will be impressed with the fact that an ironclad fan motor is just the thing. The first and worst thing that happens to fan motors is a soaking in oil from poor lubricating devices; then the likelihood of being injured on the outside by rough handling. This is all obviated by their ironclad covering.

Then in other respects this motor satisfies the critic. It runs smoothly and quietly; it is, in every sense of the word, noiseless and satisfactory. A fan outfit by this company means a good investment and an excellent means of ventilation.

A complete primary battery outfit is made by the Globe people. Their fan will run on two cells at a cost of about one cent an hour. Do not fail to embrace this opportunity. Mr. J. P. Williams, of 39–41 Cortlandt street is the general agent.

FACTORY OF J. P. WILLIAMS & CO.

(*Continued from Page* 286.)

to the transformer. The secondaries of the transformer, which are perfectly insulated from the high-tension primaries, carry the low-tension currents which are induced in the transformer through the fuse box, which is provided as an extra safeguard against the accidental flow of any dangerous current, and from there to the double-pole knife switch, which is used to turn the current on and off from the motor. (*To be Continued.*)

TEST OF MOORE'S SYSTEM.

AT the meeting of the American Institute of Electrical Engineers, held April 22, 1896, Mr. D. McFarlan Moore read a paper on vacuum tube lighting, which created considerable interest and has caused a discussion as to the power used that evening for operating the lighting tubes.

The meeting room was illuminated by 27 vacuum tubes, taking current from a 500-volt direct-current generator, driven by a 7½-horse-power C. & W. motor, connected by a belt and having the usual starting box to bring it up to speed.

When the lighting tubes with the necessary vibrator vacuum tube and magnet were put in circuit and brought up to candle-power, the motor dropped in speed and was apparently overloaded; in fact, the tubes could not be kept up to candle-power due to the decreased speed of the motor and dynamo. The machines were stopped and a hasty examination made and then restarted with the same result as before.

From the above it will be seen that the 27 tubes were apparently absorbing more power than the rated capacity of the motor, and I have heard it stated that the motor "would develop 10 horse-power before it would slow down." While no comparison of efficiency with other illuminants were made by Mr. Moore during his lecture, it seemed that the system was decidedly inefficient, or that something was wrong with the apparatus during the experiment.

On further investigation by Mr. Moore after the meeting had adjourned he claims to have discovered that the starting box of the motor was connected in the circuit in such a manner that when the motor was brought up to speed a portion of its resistance was still left in the circuit, so that the motor did not get the full potential of the supply circuit, and that this was the cause of the decreased speed in the motor when the tubes were put in circuit and the apparent overload.

At the annual meeting of the Institute, held Wednesday, May 20, in the discussion of Mr. Moore's paper the above facts were set forth by him and a number of measurements made by Mr. Jos. Wetzler, of *The Electrical Engineer*, were read, which showed that the number of watts taken by the average tube was 53.9; the measurements were made by placing a Weston voltmeter across the circuit in the usual manner, and an amperemeter in series with the apparatus, so as to measure the total energy supplied to a lighting tube, vibrator and magnet.

On account of the current passing through the instrument, being an intermitting one, the question arose as to the accuracy of the measurements, and Prof. Anthony suggested that the power supplied to the motor be measured before and after the load was thrown on the dynamo; the increase in power would represent the energy necessary to supply the lighting system and thus remove any doubt as to the accuracy of the measurements previously made by Mr. Wetzler.

During the evening exhibition of the system at the electrical show, the necessary connections were made as suggested above and readings were taken by Prof. Anthony, W. W. Ker, N. W. Perry and several other members of the Institute present, giving the results as shown in the following report:

D. McFarlan Moore.

Dear Sir:—On Wednesday evening, May 20th, in company with Prof. E. L. Nichols and Mr. Nelson W. Perry, I made a test of the power absorbed by the vacuum tube light in your exhibit at the Electrical Exposition, with results as given below.

A Weston ammeter was placed in the circuit leading to the motor used for driving the generator which furnished the current for the vacuum tubes, and a Weston voltmeter was plaeed across the motor terminals. These instruments were read at frequent intervals, while one of us in the booth below noted the time of turning on and off the light. Comparing notes, we found that when the tubes were all off, the motor consumed 12.5 to 13 amperes at 110 volts as a constant load. When the tubes were all on, the motor consumed 22 amperes at 108.5 volts. The motor, therefore, consumed:

When tubes were not running	1,402 watts.
When the tubes were all running ...	2,387 "
Due to tubes......................	985 "

There were in operation 14 tubes, 7½ ft. long, 1¾ inches diameter; one tube somewhat shorter, but 2½ inches in diameter, and a few tubes of special designs.

We estimated that the whole was an equivalent of 16 of the 1¾-inch tubes. This gives 61.6 watts per tube applied to the motor terminals. Assuming that 80 per cent. of this energy was delivered to the tubes from the generator terminals, the power consumed by each tube is 49.25 watts.

This is practically the result obtained by Mr. Wetzler, by direct measurement of the energy consumed by the tubes, and disposes of the question raised by the writer as to the reliance to be placed upon the indications of a Weston ammeter in circuit with a vibrating interrupter.

The only question now is as to the intensity of the light obtained. Of this it was impossible, under the conditions, to make any reliable estimate. Our results simply show that the light of the vacuum tubes, as exhibited in your booth at the Exposition, is obtained at the expense of a little more than one horse-power.

The instruments used in making these measurements were kindly loaned for the purpose by Mr. Pionnie, in charge of the Weston Electrical Instrument Co.'s exhibit, who gave us his assistance in making the necessary connections and in taking readings.

W. A. Anthony.

G. HUERSTEL.

A fine spark coil has just been finished by the International Electric Co. of 76 Beekman street. Mr. Huerstel was kind enough to receive the representatives of the electrical papers and show them his great inductorium. The coil was designed by Mr. B. Tropp, a gentleman that has had years of experience in this work. When the discharge rods are separated a 12-inch spark blazes across. To construct such a coil requires skill and judgment; we are therefore happy to know that the International Co. have in Mr. Tropp a person of such excellent qualities. Mr. Huerstel kindly allowed the dimensions of this large coil to be taken. It weighs about 450 lbs.; the primary consists of No. 6 B. & S. The secondary contains 100 lbs. of No. 36 B. & S., more than 150 miles of wire. The fine coils of Mr. Huerstel are obtaining a world-wide reputation. He is rushed for a long time to come.

B. TROPP.

Montreal, Que.—Electric railway building will be brisk this summer on the island of Montreal. Over 30 miles of track is to be laid by the Montreal Park and Island Railway Co. A syndicate has agreed to take that company's bonds, and build the road and furnish rolling stock and everything necessary to complete equipment of the line. The system will comprise seven miles of double track to Lachine, seven miles to St. Laurent, four miles to St. Vincent de Paul, including a bridge over the Buck River, to cost $80,000. Mr. Reid is at the head of the syndicate.

INQUIRY COLUMN.

In this column we shall endeavor to answer all questions relating to the science of electricity that may arise in the minds of our subscribers.

(*Q.*)—Ether Works.

New York, May 19, '96.

To the Editor:—I have been reading the literature of the day relating to X rays and must say that I am very much surprised at some of the opinions drawn forth from intelligent and in some cases distinguished men. I do not pose as a scientist, but as one always inclined to believe that which is most reasonable and best supported by facts. The doubts arising as to the nature of the famous Roentgen ray, in my judgment, might be divided into two parts: First as to the nature of the ray in itself, whether composed of ether in disturbance or of material particles. Second as to its cause. The weight of evidence seems to incline greatly in the first case to a conclusion that the ray is an ether wave of very peculiar characteristics. Of the second no definite statement can yet be made, except that it is either a longitudinal wave or one producing some of its effects. I would like to have your valuable opinion on the subject.

Francis M. DeLisle.

(*A.*)—Regarding the X ray we have but little to say. All papers are full of it. Your division of the question is quite satisfactory. It is an ether wave without a doubt. It has the peculiar property of diffusing from whatever object it strikes, like a heat wave. We either lack a proper knowledge of the real nature of light or of the means of investigation; probably both. There is no doubt that its cause will lay bare some very curious facts. It is not an ultra violet ray, but seems to be very much akin to it. The infiltration of light through opaque bodies adds somewhat to the confusion. We may yet prove that more than one species of ray is contained within the X ray. If light in its variations is like sound, it is likely that a surprise like this last one will not be the only one to come. We lack a knowledge of the properties of ether; and in viewing its effects must keep this fact clearly in mind.

(*Q.*)—Sparking at Brushes.

Charleston, May 21, 1896.

The Electrical Age.

Dear Sirs:—The dynamo I have in charge sparks very badly. I would like to keep my job and ask your advice. The dynamo is very cool all over, but when I throw on the load sparking begins. I have been just put in charge of it and don't know what to do. J. H., Engineer.

(*A.*)—Try to remedy the sparking by shifting rocker arm. If that do not answer your purpose use gauge brushes; if possible, carbon brushes. The trouble may exist in the machine itself; it may be poorly designed or it may be faulty in the armature. Try our first suggestion and see how you get along.

(*Q.*)—Fast Running Motor.

San Francisco, May 14, 1896.

To the Editor of the Electrical Age.

Dear Sir:—The advantages of your inquiry column being open to me I make use of your courtesy by asking the reason why my motor speeds up. I have not done anything to it and it goes at a terrible speed, and sparks like white fire at the brushes. The magnets are not hot, yet I am afraid to run it. I run printing presses with it. Kindly answer. Yours respectfully,

John Kinsman.

(*A.*)—Your armature is probably well singed. You have been overloading your motor and burnt the armature severely; the result is that a heavy flow of current takes place through the armature with big sparks at the commutator and a high speed. Get it rewound and your trouble will vanish.

EXPOSITION NOTES.

The multi-circuit system of the Brush Electric Co. was invented by Charles M. Green, the head of the Brush testing-room. A complete working exhibition of it may be seen in the Brush exhibit. This dynamo is run by an Edison motor direct connected.

The Thompson Meter Company of Brooklyn, N. Y. exhibits its new line of direct reading register instruments.

R. D. Nuttall & Co., of Allegheny, Pa., show a full line of their gears, pinions and trolleys and other work, in an attractive booth in charge of general sales agent F. A. Estep.

McEwen Compound Engines, direct-connected to its Thomson-Ryan dynamo, is one of the novelties at the electric show.

Weston Engine direct-connected to a Warren dynamo, is the latest and one of the best exhibits and worthy of the attention of all buyers.

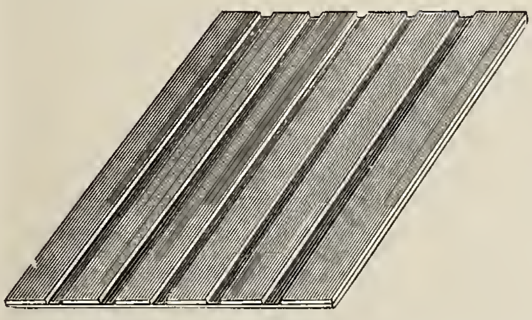
The Woodbury Engine, in the Corner Exhibit, is direct-connected to a Fort-Wayne generator. It runs as easily as a train down hill and says nothing; which speaks for itself.

The Herzog Teleseme Co., of 55 Broadway, New York, have a fine exhibit of their Hotel Call system at the Electric show. Write them for one of their souvenirs and description of their valuable appliances.

Exhibitors at the Electric Show are arranging for a great dinner Saturday night, May 30, after the termination of the exhibition.

The Sterling Boiler, on the the power floor, is shown in sectional view and is deserving of the attention of our readers. Call and see it and don't forget your souvenir.

The Heine Boiler, exhibited on the power floor, is shown in complete form and should not be missed.



ATTENTION is respectfully directed to the exhibit in the electrical exposition and to the model in motion of the trademark of the Shultz Belting Co., of St. Louis. It may also be of interest to know that electric current for the building is obtained by one of their 12-inch patent grooved rawhide belts coupling a Warren Electric Co. dynamo to a Weston engine, and one of their regular 12-inch Sable rawhide dynamo belts connecting a Crocker-Wheeler alternator to a New York Safety Steam Power Co. engine. Mr. A. B. Laurence, the New York manager, 113 Liberty street, is in constant attendance at the exhibit.

The exhibit of the Electric Storage Battery Co. is attracting its full share of attention. The company's exhibit includes a 21-foot electric launch, equipped with chloride accumulators. Portable batteries of chloride accumulators are shown operating fans and table lamps. During portions of the day the models of the Niagara power plant and of the Erie canal are operated from cased chloride accumulators stored with Niagara energy. Charles Blizard is in charge of the exhibit, assisted by Messrs. R. W. Rundle and W. G. Knudsen.

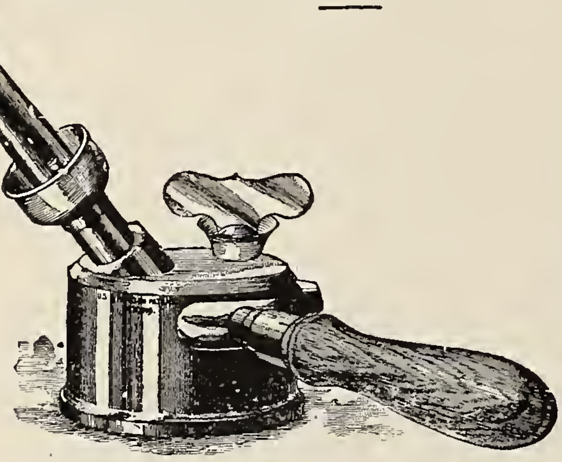
Telmic Conduit Co., of 52 New St., N. Y., have a fine showing of their conduit in their exhibit on the main floors. It is composed of combination cement, etc., and is hard, strong and tough, and perfectly insulating. Call and see it.

A prominent position is occupied by the booth of the Electrozone Company, of New York; numerous experiments show the purifying qualities of this exhibit. The exhibit is in charge of President A. E. Wolff, assisted by Messrs. J. H. Rand, James Deeks and A. S. Brown.

The Bi-Metallic Electric Transmission Co. has its headquarters with the John A. Roebling's Sons Co., where samples of its wire are given to all who desire it. A warm greeting is extended to a large number of callers by vice-president W. N. Miner and Secretary W. Stanley Eckert.

General Manager H. J. Gorke, of the Electric Engineering and Supply Co., of Syracuse, N. Y., reports doing the largest business in several years, with bright prospects for the future. He was able to spend but a short time at the convention, because of pressing business at home.

Amongst the special machinery exhibited by the Niles Tool Works, Niles, Ohio, is a vertical boring machine, direct-connected to a Card motor of the Card Motor and Dynamo Company's manufacture. At the rear of the booth is a large radial drill, which is capable of drilling a hole in a casting in any direction. The exhibit is in charge of Mr. E. D. Becker.



WE desire to to call especial attention to the Vulcan torch used by Mr. Elmer P. Morris in showing the fire-proof qualities of his monarch paint, in his corner booth on the main floor of the Electric Show. This torch was chosen by Mr. Morris on account of its power and convenience. These torches are made by The Vulcan Co., 42d street and Madison avenue, New York.

The General Electric Co.'s. exhibit at the Electrical Show is not so much a detailed exhibit of its manufactures as a pervading presence. The space occupied by the company is at the south side of the hall. Above the space against the wall is a large monogram, with the initials of the company set in different colored miniature lamps. On the tables are a number of samples of the new line of measuring instruments for alternating circuits, some of the new alternating current fan motors, and two samples of the new type H transformers. The space is enclosed with a unique railing formed of railway feeders supported by insulated suspension and turnbuckles. Left of the exhibit, in a small room, is the exhibit of the miniature lamp department. Outside of the display board, which contains a sample of every kind of incandescent lamp outside the miniature category manufactured by the company, the room contains several handsome ornamental illuminated designs, which are used to embellish the exhibit. The company is represented by S. D. Greene, J. R. Lovejoy, W. L. R. Emmet, J. Kirkland. H. C. Wirt, W. Felton, J. M. Andrews, of the Schenectady office; C. T. Hughes, T. Beran, C. Gundaker, C. G. Davenport, G. D. B. Greene and others from the New York office; C. B. Davis, F. M. Kimball, Haley, Ives and Bush of the Boston office; H. J. Buddy of the Philadelphia office; W. F. Hayes, of the Cincinnati office; A. E. Giles, of the Atlanta office, and A. D. Page, M. K. Eyre and McAllister, of the lamp works at Harrison.

Possible Contracts.

Long Island City, N. Y.—At a meeting of the Queens County Board of Supervisors the application of the Long Island Electric Railroad Co. for a franchise to extend its route along the Jamaica and Hempstead Turnpike, between the two villages, was discussed The Supervisors referred the matter to a committee of three, which will report at the next meeting of the board.

Pensacola, Fla.—A Baltimore syndicate has secured a franchise to build an electric road in Pensacola. W. H. Booley, Fayette and North streets, Baltimore, Md.

Elizabeth, N. J.—The City Council will meet, when the Plainfield Trolley Co. will ask for a franchise to build a road in Westfield Avenue to Netherwood, to connect there with the line already established.

St. Louis, Mo.—The directors of the Southern Electric Railway Co. have decided to issue $200,000 worth of bonds for improvements. W. R. Davis, secretary, general office, South Broadway.

Brooklyn, N. Y.—The Title Guarantee and Trust Co., it is said, has for some time been negotiating for the purchase of a valuable piece of property on Montague street. The plan of the company, if it succeeds in acquiring the site, is to erect a large and handsome office building.

Hamilton, Ont.—The promoters of the Hamilton Radial Electric Railway Co. have secured right of way over the Beach, crossing the canal by the new government bridge on the other side of Hamilton Bay. It is the intention of the company to start building early in the spring and to have the line completed as far as Burlington in June. The officers of the company are: Alex. Turner, president; Thos. Leather, vice-president; W. W. Osborne, secretary; W. A. Wood, treasurer; Directors: A. Zimmerman, Geo. Lynch Stanton and John Moodie.

Worthington, Ind.—The Board of Trustees of the Town of Worthington will receive bids until noon, April 30, for the construction of an electric light plant for lighting said town, and will also let contract for a brick building in conformity with plans and specifications now on file at the office of the Worthington Lumber Co. M. C. Stephenson, president. Separate bids will be received.

Orange, N. J.—A movement is on foot in East Orange to have that township lighted by electricity instead of gas. A considerable number of the citizens of the township wish to avail themselves of electricity, provided it can be secured at a low rate.

Ft. Wayne, Ind., May 23, 1896.

The Electrical Age Publishing Co.

B. S. Tolan has been appointed architect for a new $500,000 court-house for Allen county, to be built in Ft. Wayne, Ind.

B. S. Tolan.

New York City.—Plans were filed for the new School of Mines of Columbia University. It will be situated upon University Heights, adjoining the University. McKim, Head & White are the architects.

Boston, Mass.—There is a big scheme afoot in Boston for the erection of an electric theatre—a playhouse in which all the work now done by stage hands will be done by electricity.

New York City.—John B. Cole, Hotel Majestic, who recently purchased the Hotel Royal site at Sixth avenue and 40th street, is having plans prepared for a twelve or fourteen-story hotel.

New York City.—Work has begun on the construction of the new building which Ludwig, Bauman & Co. will put up. It will occupy the 36th-street front of their present site on Eighth avenue, between 35th and 36th streets, will be 75×100 feet in dimensions and eleven stories in height.

New York City.—Governor Morton announced that he had signed the bill in relation to the use of the land now occupied by the old reservoir at 42d street, New York City, for a free public library and reading room, to be erected under the supervision of the New York Public Library, Astor, Lenox and Tilden foundations.

New York City.—The Lenox Lyceum, at Madison avenue and 59th street, is to be enlarged. The property is owned by John D. Crimmins, treasurer of the Metropolitan Traction Company.

New York City.—It is reported that the old-time Astor House is to be made into a twenty-story hotel, by William Waldorf Astor, *Pall Mall Gazette*, London, England.

New York City.—The Board of Estimate and Apportionment met, May 19, to make preliminary arrangements for the rebuilding of the Tombs and for the addition of two wings to the Blackwell's Island Penitentiary. The legislature of this year authorized an expenditure of $800,000 for these improvements.

—Joseph Milbank, the purchaser of the Holy Trinity Church property, at 42d street and Madison avenue, proposes to erect a fifteen-story building on the site, to be devoted to business and office purposes. The architects for the proposed new building are Lamb & Rich.

New Bedford, Mass.—The stockholders of the New Bedford Opera House Company held a meeting in the rooms of the National Bank of Commerce. It was voted that the capital stock of the company be increased to $100,000, and that the directors be authorized to tear down or remove the present opera house building and in its place to erect a new theatre building.

New Corporations.

Saco, Me.—The Bay State Electric Heating Co. Capital, $150,000. Wm. D Tuttle, of Newtonville, Mass., and Louis P. Hager, of Waltham, Mass.

Montpelier, Ind.—The Montpelier Street Car Co. has been incorporated with a capital of $10,000.

Tacoma, Wash.—Central Electric Manufacturing Co. Capital, $50,000. Incorporators, E. E. Salisbury, A. F. Dean and others.

Bowling Green, O.—Electric railroad connection with Toledo is an assured fact. The incorporation papers have been forwarded to Columbus, and the stock necessary to build has been subscribed. The new company is called the Toledo, Bowling Green and Fremont Railway Co. It will have an authorized capital of $500,000. Stockholders, Parks Foster, of Elyria, Ohio; Thomas H. Walbridge, Dean, V. R. Libbey, M. I. Wilcox, R. S. Parker, of Bowling Green.

Dayton, O.—The Troy, Tippecanoe and Dayton Electric Railway Co. is the latest applicant for right of way through Montgomery County. The proposed route in this county is over the Miami and Montgomery Pike through the towns of Vandalia and Chambersburg, to the bridge crossing the Miami River at Webster street.

Yonkers, N. Y.—The certificate of consolidation of the Yonkers Railway Co., the North and South Electric Company, and the Yonkers and Tarrytown Electric Railroad Co. was filed. The name of the new corporation is the Yonkers Railroad Company. Capital, $1,000,000. Incorporators: Albert L. Johnson, of New York City; J. F. Van Name and Albert Crolius, of Brooklyn, and Channing Burnz, of Scarsdale.

Lewiston, Me.—Articles of association have been filed in the office of the railroad commissioners for the new Lewiston and Brunswick Street Railroad Co. Those interested are N. Q. Pope, F. V. Dana, Henry W. True, Wm. T. Smart and Orlando Ham. The length of the road is to be 21 miles and the capital, $200,000.

Telephone Notes.

Bryan, O.—Bryan is to have a telephone exchange.

Milledgeville, Ga.—The Milledgeville telephone system has been bought by C. W. Richter and G. C. Smith, and will be improved by them.

Sandersville, Ga.—The system of the Sandersville Telephone Exchange will be increased from 25 to 100 telephones. The lines will also be extended.

North Lubec, Me.—A telephone line between North Lubec and Eastport is talked of.

Jamestown, N. Y.—Jamestown is to have a new telephone system.

Paragould, Ark.—The Paragould Telephone Company has been incorporated by A. A. Knox, F. Hoffman, M. F. Collier and others.

Clinton, S. C.—The Clinton Telephone Co. has received a charter. Capital stock, $1,000. A. B. Blakely, president; J. A. Bailey, vice-president, and H. L. Horton, secretary-treasurer.

FOR UPTOWN TELEPHONE SUBSCRIBERS.

An uptown branch of the Contract Department of the Metropolitan Telephone and Telegraph Company has been established at 113 West 38th street (one door from Broadway), where all business relating to the supply of telephone service can be transacted as readily as at the main office at 18 Cortlandt street. There are 15,000 telephone stations in New York City. Metallic Circuit Service, Rapid, Efficient, Permanent, can be had from $75 a year.

TELEPHONE PATENTS, ISSUED MAY 14 AND 19, 1896.

558,354. Telephone-Transmitter. William R. Cole, Detroit, Mich. Filed May 15, 1894.

558,385. Telephone-Bell. Richard D. Harrigan, Leadville, Colo. Filed Nov. 5, 1895.

558,106. Connection for Telephone Apparatus. Parnell Rabbidge, Sydney, New South Wales. Filed May 20, 1895.

560,212. Circuit for Patent-Signal Transmitters. Felix B. Herzog, New York, N. Y. Filed Feb. 14, 1895.

560,275. Switchboard. David M. Munro, Gaithersburg, Md. Filed Feb. 26, 1896.

560,403. Telephone Receiver. Stephen D. Field, Stockbridge, Mass., assignor to the American Bell Telephone Company, Boston, Mass. Filed Aug. 24, 1895.

560,617. Telephone Signal and Signaling-Circuit. Achilles De Khotinsky, Boston, Mass., assignor to the American Bell Telephone Company, same place. Filed Mar. 13, 1890.

It is questionable whether to some characters education and culture are a benefit or a curse. They are to some the only impediment. The habit the mind gets into of satisfying itself about all things is a fault that may be traced—a culture that coils upon itself with a venomous activity.

People of ordinary life by voicing a sentiment in chorus do but awaken the slumbering genius. Of the people—they reap the benefits of his work, feeling for him the sympathy that proceeds from the closest affiliation. The rough gems of mankind reflect from every facet the thoughts—the forceful ideas that change and mould the careers of the multitude—that awakens in them the consciousness of further change, and of inevitable progress.

ELECTRICAL and STREET RAILWAY PATENTS.

Issued May 5-12, 1896.

559,349. Rheostat. William S. Andrews, Schenectady, N. Y., assignor to the General Electric Company, of New York. Filed Dec. 12, 1895.

559,356. Electric Railway. Henry Brandenburg, Chicago, Ill. Filed Mar. 11, 1895.

559,380. Electric Motor and Motor-Generator. Ludwig Gutmann, Chicago, Ill. Filed July 10, 1894.

559,387. Electric-Arc Lamp. Albert Jordan, Vienna, Austria-Hungary. Filed Feb. 12, 1896.

559,397. Electric Signalling Apparatus. Thomas G. Morse, Erie, Pa. Filed Oct. 8, 1895.

559,407. Electric-Arc Lamp. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed Dec. 30, 1893.

559,416. Electric Push-Button. George J. Soper, Brooklyn, N. Y. Filed May 17, 1895.

559,419. Inductor-Dynamo. Charles P. Steinmetz, Schenectady. N. Y., assignor to the General Electric Company, of New York. Filed Feb. 15, 1896.

559,479. Telegraphic Relay. Charles G. Burke, Brooklyn, N. Y. Filed Nov. 21, 1895.

559,530. System of Electrical Distribution. John F. Kelly, Pittsfield, Mass., assignor to the Stanley Electric Manufacturing Company, same place. Filed Nov. 20, 1895.

559,531. Dynamo-Electric Machine. John F. Kelly, Pittsfield, Mass., assignor to the Stanley Electric Manufacturing Company, same place. Filed Jan. 18, 1896.

559,535. Electric Belt. George N. Moore and Robert C. MacCulloch, New York, N. Y., assignors to Albert T. Sanden, same place. Filed Apr. 17, 1895.

559,576. Electric Railway-Signal System. Laban J. Everest, Omaha, Neb., assignor to the Everest Railway Signal and Switch Company, same place, Chicago, Ill., and New York, N. Y. Filed July 12, 1895.

559,584. Dynamo Electric Machine. John F. Kelly, Cummings C. Chesney, and Pomeroy W. Power, Pittsfield, Mass., assignors to the Stanley Electric Manufacturing Company, same place. Filed Jan. 22, 1896.

559,586. Electrical Contact Device for Subways or Conduits. Alvaro S. Krotz, Springfield, Ohio, and William P. Allen, Chicago, Ill., assignors of one-third to Oliver S. Kelly, Springfield, Ohio. Filed Nov. 14, 1895.

559,648. Electric-Arc Lamp. Malone Wheless, Washington, D. C., assignors by mesne assignments, to The Wheless Electric Lamp Company, same place. Filed Dec. 7, 1895.

559,692. Armature for Electric Motors and Dynamos. Jonathan J. B. Fiske, Alliance, Ohio, and Howard A. Littlefield, Lynn, Mass.; said Littlefield assignor to said Fiske. Filed Dec. 14, 1894.

559,711. Marine Torpedo. Louis P. Johnson, Walter J. Slacke, and Howard Lacy, Easton, Pa. Filed Feb. 21, 1895.

559,721. System of Electrical Distribution. Benjamin G. Lamme, Pittsburgh, Pa., assignor to the Westinghouse Electric and Manufacturing Company, same place. Filed Apr. 11, 1895.

559,796. Electrically-Operated Railway-Switch. August C. Goetz, Milwaukee, Wis., assignor, by mesne assignments, to William C. Henry and H. Samuel Esch, same place. Filed Aug. 24, 1893.

559,800. Automatic Track Switch for Electric Railways. William C. Henry, Milwaukee, Wis., assignor, by mesne assignments to himself and H. Samuel Esch, same place. Filed Dec. 20, 1893.

559,801. Electric Light for Bicycles. Benjamin B. Hoffman, New York, N. Y. Filed May 24, 1895.

559,821. Telegraph Printing Apparatus. Hollon C. Spaulding, Boston, Mass. Filed Apr. 23, 1895.

559,863. Electric-Arc Lamp. Samuel E. Nutting, Chicago, Ill. Filed Oct. 18, 1893. Renewed Oct. 14, 1895.

559,869. Selective Signal and Lock-Out System. Charles E. Scribner, Chicago, Ill. Filed May 18, 1895.

559,872. System of Electrical Transformation. Philip K. Stern, St. Louis, Mo., assignor of one-half to H. W. Kirchner, same place. Filed Sept. 16, 1895.

559,889. Electric Clock. Benjamin Franklin (Mary A. Franklin, administratrix of said Benjamin Franklin, deceased) and David H. Fletcher, Chicago, Ill., assignors of one-half to George H. Merriell and Calvin R. Beach, same place. Filed Apr. 11, 1893.

559,891. Car Fender and Brake. Charles F. Grather, New York, N. Y. Filed June 7, 1895.

559,903. Steering-Gear for Ships. Mathias Pfatischer, Philadelphia, Pa. Filed Aug. 24, 1895.

559,904. Electrical Steering-Gear, Mathias Pfatischer, Philadelphia, Pa. Filed Dec. 26, 1895.

559,907. Running Compound-Wound Generators in Multiple. William B. Potter, Schenectady, N. Y., assignor to the General Electric Company, of New York. Filed Feb. 25, 1896.

559,910. Armature for Dynamo-Electric Machines. Henry G. Reist, Schenectady, N. Y., assignor to the General Electric Company, of New York. Filed Jan. 31, 1896.

559,916. Electric Switch. Paul G. Tismer, New York, N. Y. Filed March 29, 1895.

The Electrical Age.

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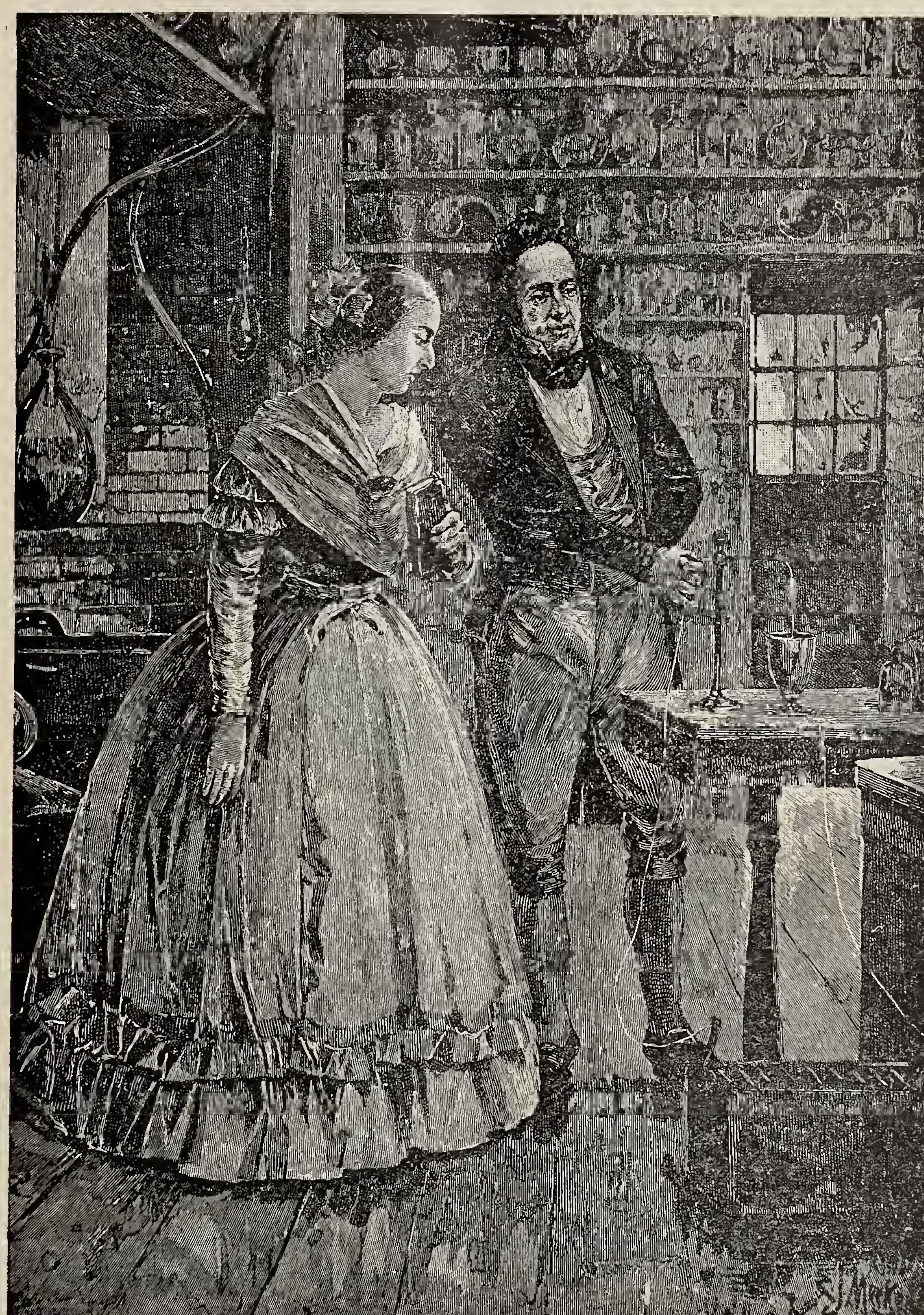


FARADAY IN HIS LABORATORY.

MICHAEL FARADAY.

The progress in science has been very rapid since the last hundred years have passed.

Many notable discoveries were made; many unworthy principles laid bare that had stayed the advancing spirit of the times. In many fields of science the most remarkable facts have come to light. There is no man living at present that can afford to ignore the labors of earlier workers, none that can gainsay in one respect the rigid demonstration of hitherto unknown laws. It is upon this solid substratum of truth that progress has been made possible. There are many to whom a share of this honor is due, and the eye in retrospect sees such figures as Newton, Bacon, Helmholtz and Faraday flit by. The great efforts of these men and their remarkable successes make us owe to them our present position in science. There is a great unexplored region still lying in shadow, but the present means will enable us to readily advance with dispatch. The discovery of gravitation was the result of prolonged observations and systematic experiment. Likewise any other great discovery. The principle of the conservation of energy— that energy is indestructible and that its *loss* is only apparent, was a great step forward. Much of our present headway is dependent upon this luminous principle.

The indestructibility of matter and, in fact, the perpetual persistence of all things is a parallelism dependent upon the above.

With the fact firmly established in mind that the forces of nature do not diminish in value and that a transformation is all that ever occurs, the after-truths unearthed by later scientists become of greater importance and value. There is in science a centre from which radiates all the departments of investigation: chemistry, heat, electricity, magnetism, etc. The centre of which we speak is force, and in all reactions its changes are evident.

Michael Faraday has discovered a principle as wonderful in its bearing upon abstract science as that of gravitation. Each are the names for changes whose effects manifest themselves in the attraction of bodies and the generation of a current. Faraday has identified himself with the subject of induction, yet his simple and practical methods of research in other fields give him a place far above his associates, even his early instructor, Sir Humphry Davy. The realization that light waves and lines of force possessed features in common was a thought that continually found expression in his work. His attempts were the first to show some relationship, and the conclusions mathematically deduced by Clerk Maxwell are but a verification of his own advanced opinions.

AMPERE.

Faraday in his experiments in electromagnetic induction sought in the revolving copper disk the power consumed in its rotation. A great many inferences might have been drawn by the careless reasoner and the transformation of mechanical power into electricity not even dreamed of. But Faraday kept the single idea in mind that the opposition to motion must be the result of some remarkable change. His careful investigation of the copper disk and *conclusion*, that in the disk itself power was absorbed, was sufficient to exalt him above the men of his time.

The current created in the disk by rotation in a magnetic field was a development that excited the greatest of attention. We are so accustomed to considering force as a phenomenon that can be felt, that can impress us from a physiological standpoint, that this unlooked for variation was the beginning of a host of new experiments. The principle could not be assailed successfully. It stood forth in all its simplicity and excited a wide circle of metaphysicians to heated discussions. There is in so radical a departure from the old methods of generating a current a touch of the marvellous.

A magnetic field that does not affect the senses in any respect has a metallic body moved in it and develops a current!

The absence of any visible change was the cause of much surprise. The theory of action at a distance had not taken such a firm hold on the thinker, as yet, to allow him to witness its exposition without wonder. The reason for such an action was sought for in the principles governing all cases, a mere transformation of energy.

It has enabled us to see why a current issues when power is applied, but it does not explain the *process* by which the transformation occurs. From a practical standpoint Faraday concluded that the effects were most valuable to the world. While this is eminently true, it would be, as it has proven in the past, a source of deep interest to engineer and scientist alike to know the inward, invisible change producing an electromotive force in the copper.

Some of the greatest tonics in the world are the greatest poisons. The tissues of the body are controlled by the nerves. When the nerve energy disappears, the body is incompetent to struggle or resist the physical foes of life. It is out of the race, and in every sense of the word, dead. The relations existing between the brain, nerves and flesh are very definite. Paralysis may be caused by disease in the nerves, as well as by disease in the brain.

When a current passes through the system, involuntary action is caused by its effects upon the sensory organs, the muscles and the nerves.

A current may so affect the tissues as to stay all functions and thus kill. An able authority claims that a severe shock may bring on paralysis, epilepsy or insanity. The most curious fact in connection with death by electricity is the lack of any sign of disease in the organs. The change seems to be a profound and uniform molecular one. Tissues may be burnt, and capillaries burst, but the other effects are beyond our most careful analysis. All vital action is at once suspended and in certain cases not a trace left to show the cause.

"Dynamic Appolexy" is the name given to death by electricity by some physicians. The brain becomes suffused with blood and all the signs of a violent apoletic attack appear upon examination. In moderation, an interrupted current is of the greatest use in surgery and medicine. As a means of diagnosis it is in certain cases invaluable. In excess it will kill with a certainty more absolute than strychnine or Prussic acid. No physiological shock can exceed that due to a powerful high-tension alternating current.

ARC LIGHTING AND THE INSTALLATION OF MOTORS.

LESSON LEAVES

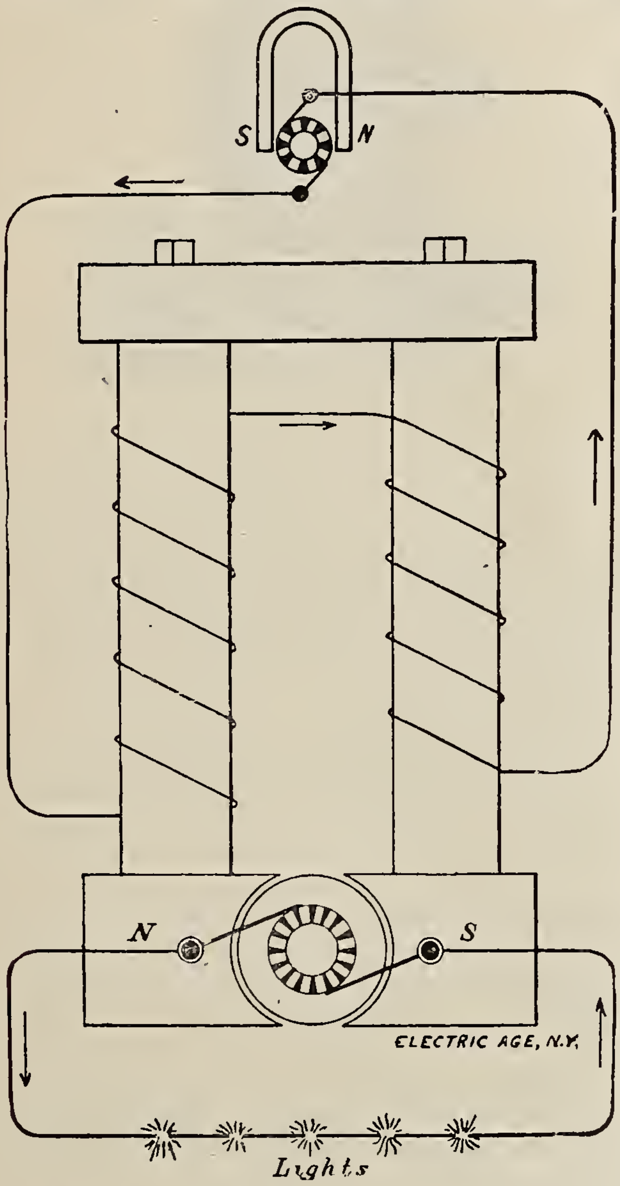
FOR

THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

When a motor is to be installed certain precautions must be observed in order that no injury from fire can result and no danger from shock exist.

The fire underwriters of every large city impose limitations upon contractors and prevent them from doing careless work. It is usual to mount the motor upon a fireproof foundation and have a large pan underneath to catch the oil drippings. A zinc pan is frequently used for this



purpose, the motor being mounted in the centre of it. The starting box must be of slate and have under it a large sheet of asbestos paper. The fuse blocks, devices used for the protection of a line, must be covered to eradicate the dangers of fire from the vaporized metal.

In total the installation of either motor or dynamo must be based upon the fact that the risks from shock and fire are to be entirely removed. A low voltage motor or dynamo does not introduce much danger from mere shock; in this respect, up to about 400 volts the person in charge is secure, but the chances of fire always exist.

A loose hanging connection, a short circuit on the line, a bad ground, etc., may bring about this danger unless regular tests are made to keep the line clear and dynamo insulated. A lightning arrester is a very necessary adjunct to a plant having an outside line. Frequently a station is destroyed by lightning according to report. This may not be true, although lightning is in many cases the original cause. Lightning by striking a line, or dynamo through the line, usually sparks across every available gap.

An arc is thus started and continued by the generator itself. It is thus very likely that in many instances the burning is done by the dynamo current, although the original cause—lightning—has long since disappeared. Protectors in many cases fail to protect because there is a certain element in lightning arresters that must be improved, and a peculiar oscillatory nature to the discharge that must be better understood in its many variations before they can be used with certainty in every case.

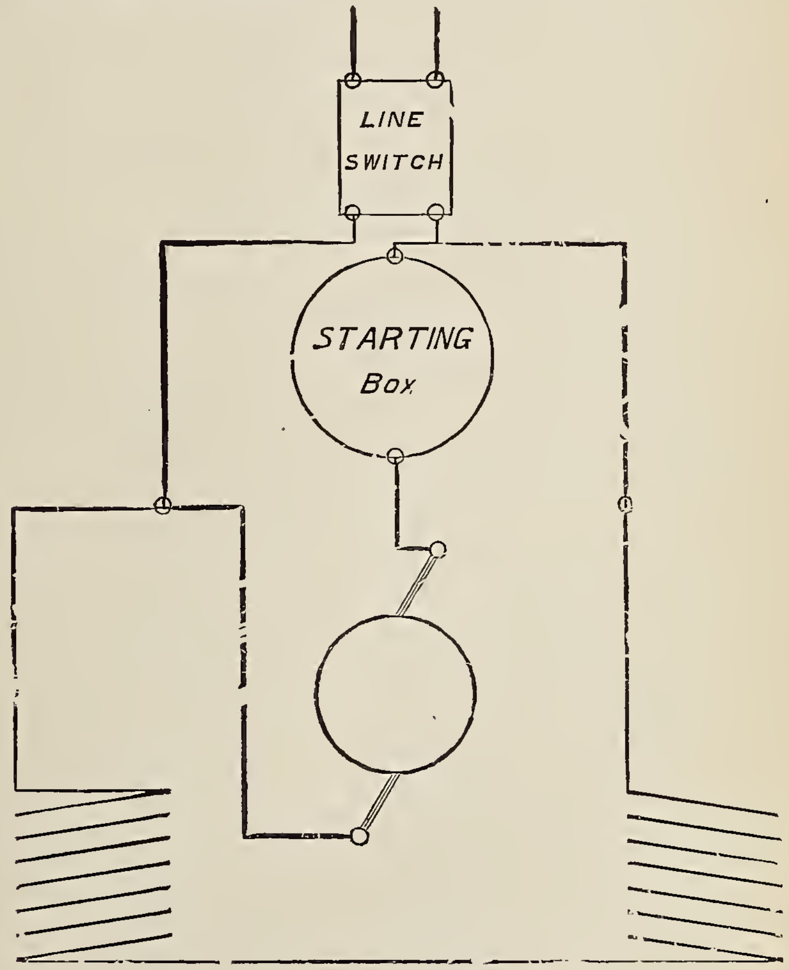
Both dynamo and motor are protected from an overflow of current by means of a safety fuse or cut-out. This is simply a piece of lead wire inserted in the circuit and of such a size that a flow exceeding the regular amount will melt it and open the line. The danger being over it is then replaced by another piece. Good insulation to either dynamo and motor, good safety devices, in the shape of either cut-outs or lightning arresters and a drip pan to catch the oil, comprises the essential elements of a good installation.

Arc Lighting Machines.—Arc lighting machinery differs from incandescent in one or two respects.

As a rule arc light machinery is of higher pressure; it is also series-wound and therefore regulated differently, and in addition the line is a simple series circuit. The high tension or direct current dynamos, as they are often called, require an attendant, only valuable if experienced and ready to grasp a situation at times filled with deadly danger.

The case of high tension arc machinery is not the pleasantest occupation in the world. There is a series dynamo, the armature of field winding forming one continuous circuit in addition to a long outside line.

Pressure of Arc Lamps.—The string of arc lamps connected to the outsine line each require 50 volts. The pressure developed by a machine is automatically regulated according to the number of lamps in circuit. A 50-light machine would generate $50 \times 50 = 2,500$ volts, if fully loaded, yet it will give anything less than that up to 50 volts if so required.



CONNECTIONS OF MOTOR.

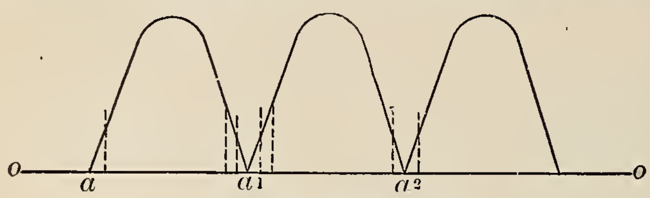
Regulation.—To control the voltage of any dynamo it is necessary to vary either the

speed,
armature turns, or
field strength.

In practice the speed cannot be changed, as the engine runs at a fixed number of revolutions per minute. The field strength may be varied, or the armature controlled so that its full pressure is not collected at the brushes. The two methods employed, therefore, may be defined under the following headings :

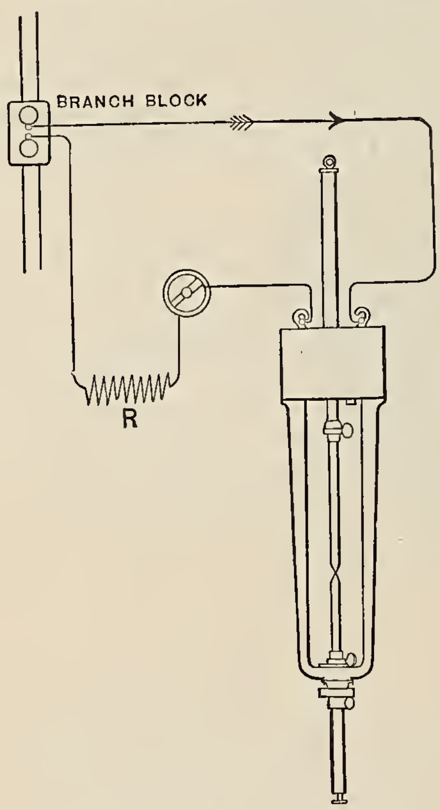
Regulation of field.
Regulation of armature.

By shunting the current of the field on and off automatically, will supply more or less lines of force to the armature.

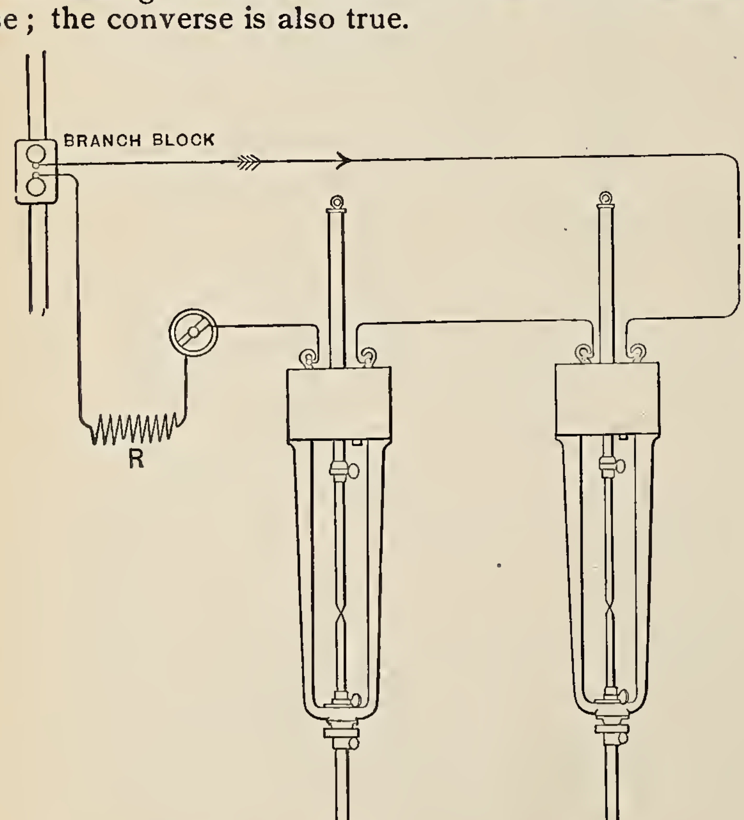


DIRECT CURRENT.

An electromagnet may do this governed by the outside line; when the current is too strong, the pressure is reduced by decreasing the field and the current diminishes likewise ; the converse is also true.



ARC LIGHT ON 110 VOLTS.



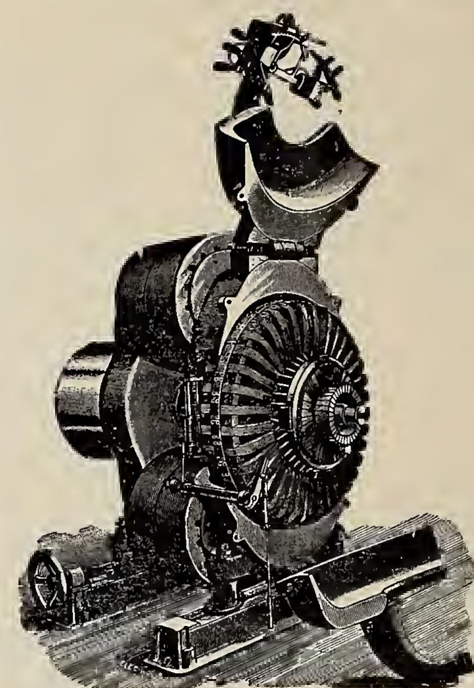
CONNECTION OF TWO ARC LIGHTS ON 110 VOLTS.

We are now prepared to enter into a general classification of all continuous current dynamos, namely :

Constant current and
Constant potential machines.

The object of all arc light high tension systems is to preserve a constant current of about 10 amperes and regulate the pressure to the number of lamps used to the extent of just 50 volts apiece. In incandescent dynamos the pressure is kept constant and the current varied to suit the number of lamps.

The regulation of each is, in one case, with reference solely to the current; in the other, to the pressure. Therefore shunt wound or incandescent dynamos and series-wound or arc light dynamos are strikingly different in this respect. Dynamos that supply incandescent lights are used for arc lighting also. They obtain their current in shunt from the main current, and are treated like large incandescent lamps in consequence. For long distance lighting or the illumination of straggling, towns high tension systems are cheapest.


HIGH TENSION ARC MACHINE.

The regulation of arc systems by means of a special device affecting the armature are most popular. By shifting the brushes on a commutator, the pressure may be varied from nothing to its highest value. If this change in volts is in exact correspondence with the load or number of lamps, then the purpose of automatic regulation is fulfilled. This is also done by means of an electromagnet in series with the line. When the load is lessened by lamps being removed the pressure, acting through a decreased resistance, increases the current momentarily; this strengthens the magnet and it pulls the brushes over to a point of lower pressure. These positions of the brushes and volts required for lamps must correspond. The brushes must not move too far or too little, but must be adjusted to touch at the required point of the commutator.

This is practically equivalent to changing the turns on the armature. Therefore, it is seen that the methods of arc light regulation depend upon either a change in field or in effective turns.

Ste. Rose, P. Q.—The Montreal Park and Island Railway Company have been doing a good deal of work of late preparatory to an energetic season's operation, to be commenced as soon as the frost is out of the ground. A few days since Mr. Corriveau went to Ste. Rose in the interest of the road and his cordial reception at the hands of the people of that parish indicated the ardent desire of the community to be connected with the city at an early day by an electric tramway. Messrs. Holgate and Corriveau also interviewed the people of St. Vincent de Paul, where the electric railway fever is very general amongst the inhabitants. Mr. Corriveau paid a second visit to St. Vincient de Paul and Ste. Rose, and it is understood that the property owners on both sides of the river are ready to grant a free right of way. Ste. Rose also offers strong inducements to have the railway extended to that parish, so it is quite probable a good deal of work will be done during the coming season.

THE EVOLUTION OF THE ARC LAMP.

L. H. ROGERS.

(*Continued from page 281.*)

WE can see Davy's two pieces of charcoal—one is 12 inches long and the other six; the rate of consumption has not changed. We realize that the useful length of this lamp is the vertical length of the carbons. Dividing 18 inches by 50 inches we find that the *useful length of this device is only 36 per cent. of its total length.* The statement may be made by some enthusiastic observer that there are two pairs of carbons, one pair alongside the other, but he must not forget that with our improved eyesight in 1896 we can look clear through the device, and see not only the skeleton but the marrow in the bones.

These carbons are fastened firmly in their respective holders, and the holders are rigid. The burning of the arc causes the carbons to point up quite decidedly. When the current is shut off momentarily, these points fall together, and it very often happens to slip by each other and wedge. When the current is again sent through the coil, its lifting power is not sufficient to pull the carbons apart; the lamp is rendered utterly useless; the policeman reports it out, and a deduction is made from the bill of the lighting company to the city. To prevent these deductions amounting to more than the original bill, a corps of patrolmen are engaged, whose business it is to watch the lamps all night long, to prevent them going out, as a nurse would watch a sick child.

We find the interior of the devices full of springs, some of them with ratchets and cog-wheels, some with six magnets or coils, all with three or more; springs without number, and of every size; regulating devices, auxiliary levers, light and flimsy pieces of every shape and size; the device for gripping the rod in most cases an annular ring gripping the carbon rod by tilting so that its knife-edge holds on the side of the rod, the current being conducted to the carbon-rod by means of a sliding contact; delicate brushes against which the carbon-rod rubs as it feeds the carbons downwards; cut-out spools which have little side shows of their own with independent armatures, and additional coils of wire; carbon rods sticking away up into the dark recesses of the chimneys; rods which must be carefully housed and carefully cleaned with crocus cloth each day. We notice also that for three or four inches above the casing the rod cannot be cleaned by the trimmer; it therefore becomes spotted; a bit of weather or a bit of dust changes the nature of the brass, and the current-carrying brush when it reaches this spot does not make a good connection; a little blister is formed, which in turn blisters the surface of the brush, and this in turn blisters the rod the entire length until crocus cloth is powerless to smooth it. The lamp then must come in, for in the meantime many other little things have happened and nothing but a thorough overhauling will put the lamp in good condition again.

It would require a volume to recount the details of the troubles that are occurring every hour, in every lighting plant on the face of the globe. You, who are within reach of my voice, know too well that your arc lamps give you more trouble than all the rest of your apparatus combined. These troubles have come upon you so gradually, however, that you have become accustomed to them. It seems that some station men actually delight in keeping a force of men repairing old lamps, and a horse and wagon busy hauling them in and taking them out again.

Alexander Dow, electrical engineer for the city of Detroit, connects four 100-light dynamos to one engine, for the reason, as he states, that the ratio of troubles is four to one. I wonder how many dynamos would be connected to each arc lamp, or arc lamps to dynamos, provided the number were dependent on the ratio of troubles?

And now we have reached the year 1896; we have given the arc lamp a 20 years' tussle, and our troubles are increasing rather than diminishing. The lamp cuts the same kind of a figure against the sky, as it did in the year 1875. Many details have been added in the interior construction—more magnets and more springs and more cut-outs and more chimneys, and less glycerine, but I do not think the statement can be denied that not one single idea of great merit has been added to the arc lamp between 1875 and 1895.

(*To be Continued.*)

Interesting Facts in Science.

An Ethnological North Pole.—Perhaps the most interesting question to be solved by the discovery of the North Pole is the question whether or not any human beings are to be found in its vicinity. It is not wholly improbable. The town of Werkojausk in Siberia is situated in north latitude 68°. Whether or not human life will be found at the Pole, it is certain that the unexplored Pole region is inhabited by various animals. The rosy gull, two species of sandpiper, as well as at least one variety of ducks, is known to breed there. There is good reason to believe that fish abound in the open Polar Sea, and the probability of a flora as extensive as that of Spitsbergen, mosses and lichens with perhaps a few flowering plants, such as the yellow Arctic poppy.

Utilizing the Earth's Internal Heat.—Some interesting companies are reported to be engaged in methods for utilizing in a practical and economical way in Hungary—names and localities not stated—the earth's internal heat for power and for the wide range of domestic purposes. It appears that for many years the artesian wells existing in that country have copiously supplied hot water, which has been used for a variety of purposes, such as public baths and buildings; also for warming greenhouses, winter gardens, etc. The plan, however, has for a long time been in contemplation, it is stated, of sinking such wells to some 12,000 or 15,000 feet; the water from such a depth would, it is believed, have a temperature of about 2,000° C., and capable, therefore, of yielding steam for power, as well as the heat required for warming buildings.

How Gold was Deposited.—An exhibition of the greatest interest to mineralogists and practical miners in relation to the much-argued question as to how gold was originally deposited in auriferous quartz is reported from the Imperial Institute, at Edinburgh, Scotland. J. C. F. Johnson, of Adelaide, Australia, who has given great attention to the subject, exhibited specimens of non-gold bearing stones in which he has artificially introduced gold in interstices and on the face in such a manner as to defy detection, even by skilled experts. Some of these specimens were shown privately to several distinguished geologists, who expressed great surprise at the remarkable character of the exhibition. The discovery, some years ago, that gold could be induced to deposit from its mineral salt to the metallic state on any suitable base, such as iron sulphide, led Mr. Johnson to experiment with various salts of gold, and by which he has produced most natural-looking specimens of auriferous quartz from stone which from previous assay contained no trace of gold. Moreover the gold, which penetrates the stone in such a thorough manner, assumes some of the more natural forms. In one specimen shown the gold not only appears on the surface, but penetrates each of the laminations, as was proven by breaking. While this knowledge of how gold was probably deposited may help to suggest how it may be economically extracted, the thought also occurs what a power for harm it would be, in unscrupulous hands, for the fraudulent "salting" of mines.

WINCHESTER, N H.—The people of Winchester are raising money for a telephone line to Richmond.

RECENT DEVELOPMENTS IN VACUUM TUBE LIGHTING.

BY D. MCFARLAN MOORE.

(*Continued from Page* 284.)

D. MCFARLAN MOORE.

ANOTHER way of obtaining a rotary motion within a vacuum is to attach a pendant weight to a ratchet wheel, free to rotate upon a shaft attached to which is the brush. Since the shaft is rigidly sealed into the glass, it is evident that when the bulb be rotated by a motor, the brush will revolve around the break-wheel. The fault with the device is that the pendulum will have a vibration of its own, causing the light to waver.

In order that the make-and-break devices dependent upon a rotary motion be absolutely positive, a rotating magnetic field has been utilized. Since the experimental side of these investigations has extended over but a few months, it is at present difficult to say upon which of these methods, developed, the system will take final form.

Returning once more to the subject of the light in the tube. It is interesting to note, that although the most intense light is produced when both of the ends of the tube are connected to the electrodes, it is well known that light also results when the tube is merely placed near an electrode without actual contact. This phenomenon is known as lighting by induction.

If an inductive circuit, sufficiently powerful to brilliantly illuminate a tube four feet long, be transferred to one two-feet long, there will appear at the centre of this small tube a very intense thread of silvery white light, which undulates as if it were a material substance. It is interesting to contrast the color of the light of these tubes with that of an incandescent lamp. The reddish and wasteful glare of the latter, indicating heat waves, and the pure daylight white of the former, is immediately apparent. It is this difference in color that makes an efficiency calculation so difficult. It is very easy to ask the question: How many watts per candle-power? But in most instances it indicates a lack of information on the part of the questioner. The question should be: How many watts per amount of light equivalent to one candle-power? But even this is not perfectly correct, because it is well nigh impossible to compare accurately lights of a different color and power of diffusion. When the *use* the light is to be put to is stated, the problem is much more simple. For instance, if it is to be used to read by, the range of legibility can be made the basis of comparison between the true glow lamp and the candle. This most popular form of illumination, from the 12th to the beginning of this century, is still the standard of illumination, although it is probable it will soon be deprived of this honor. I may be pardoned for calling your attention to the remarkable intensity of the light in these tubes, in connection with the statements repeatedly made by eminent scientists, that such intensity was an impossibility, and that efforts in this direction were comparable to those wasted on perpetual motion. It is merely another instance of history repeating itself, in that in all times the inertia of the learned has interfered more with the progress of science than has ignorance. Be it remembered that the commercial incandescent lamp was an acknowledged impossibility among scientific men, and that by them the proposed Atlantic cable was considered foolishness. If there be but one lesson taught by our times, it is, condemn nothing *new* in religion, science or art without thorough investigation, and even then be careful, because many suggestions, though of little value themselves, have led to great advancement. It is also well to remember that there is almost a creative force in the spirit that is earnest and courageous. The light having reached the intensity as you see it in this tube, it is questionable whether much greater intensity is wanted. The vibrator, as applied to the electric bell, was the first practical application of electric power, and today we see the same vibrator in a "new light."

The very nature of the light, if it is to be counterpart of the ideal-daylight, is such that when a square inch of the surface of the tube emits as much light as that thrown into a room through an aperture one-inch square, the want is satisfied. Then the desired illumination can be reached by multiplying the area and length of the tubes, and distributing them in the most advantageous manner; that is, so that the light will fall from all directions.

When a considerable area is to be lighted, the most efficient light is the one that is most equally distributed. However, there will always be a demand for units of light.

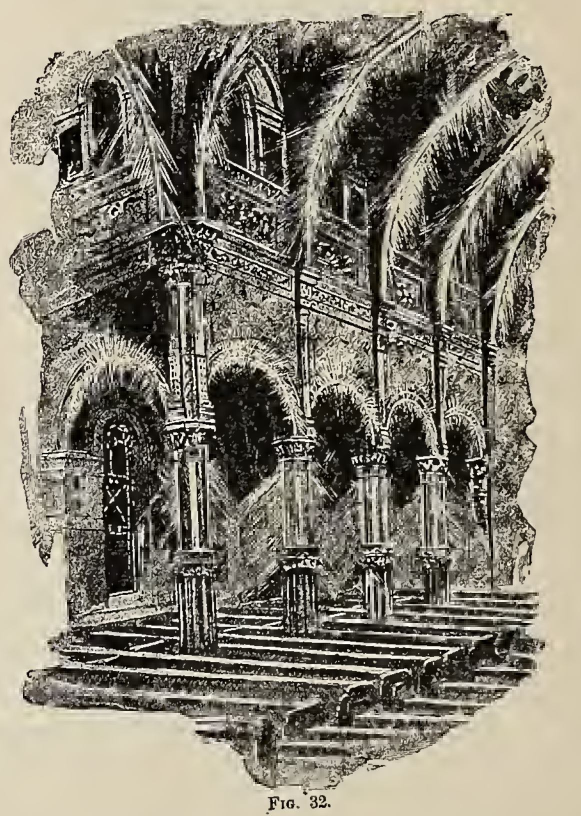


Fig. 32.

Even this can be satisfied by using a tube of small calibre. This lamp is made by winding a small tube in the form of a spiral, its ends, to which the wires are attached, terminating in oblong bulbs three or four times the diameter of the small tube.

I have previously stated that the alphabet has been constructed of tubes of light. Here are the initials of the body I have the honor to address, A. I. E. E., in letters twelve inches high. The delicate shades of these letters cannot fail to elicit admiration from all who love the beautiful.

The principle of breaking a circuit in a vacuum has many applications to a variety of uses. Among them may be mentioned, advertising signs, decorative electric lighting, electrotherapy, philosophical apparatus, theatrical effects; in the manufacture of ozone, in the kinetoscope, etc., etc.

But the greatest field will ultimately be that of general illumination. You have noticed the tubes extending around this hall. Undoubtedly this is the first time that lighting by tubes has been attempted on so large a scale. You will note the almost entire absence of shadows.

Fig. 32 illustrates what we are coming to in the way of church lighting. For some time past everything has pointed to the general adoption sooner or later of some such form of illumination, and since volumes of light can now be produced, and of commercial intensity, does it not indicate that already this light is a matter for serious practical consideration, and no longer a pyrotechnic curiosity?

But the only way in which one can form a comprehen-

(*Continued on page* 300.)

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CONTENTS.

INVENTORS AND INVENTIONS.

There is a doubt existing amongst many as to the true meaning of the word "inventor." To originate a new article of popular or technical interest is sufficient to cause the expression to be used. Few of so-called inventive power have more than made additions to the large stock of inventions of a similar if not identical nature. A patent that is granted is not always proof that an invention has been made. An army of men make it their business to simply improve what already exists.

Few create entirely or make a radical departure from the beaten track. The discoverer of a new principle rarely makes an application of it himself. The ability to discover a new law requires a perfect equipoise of the reasoning abilities; it may not suffice at all for the construction of a machine making use of the discovery. Again it is a familiar fact that the original inventor of a new machine makes but few changes in its crudity, but the host that follow perfect it in detail until we have as an example, side by side, the first rough design of Watt and the elaborate triple expansion engine of a modern marine equipment.

The unfinished idea does not lose in value because it is not perfected. Like a rough casting it needs finishing and polishing. The general structure does not pass through other than detailed processes insignificant individually in comparison with the whole, but of equal importance in the concrete. An inventor may enter into either fields as his native qualities appear. It is therefore necessary to divide inventors, and therefore their inventions, into two classes; the first greater than the second. The first headed by such m ɜn as Watt; the second greater class, those that added their mite to the pile. Inventors may therefore invent the entire device; that is, originate the base of a great superstructure, or he may simply add or improve some necessary adjunct. The steam-engine represented the original idea; its further application to rail and water required comparatively few changes in other than its external form. But the use of the governor, the thousand and one details, each of which was and are the subject of special study, give a perfect illustration of the variations and striking differences between "inventors and inventions."

CARBON.

Some departments of trade are very old. In this science, with all its apparent youthfulness, a single branch of business dates back many years.

The manufacture of carbons for electric lights is today one of its most important. A carbon and a diamond differ but a few per cent. from each other in purity. To obtain from carbon a light as pure and brilliant as that of the diamond is the point to which all standards reach. The incandescent lamp has gone through many changes. In earlier days its filaments were laboriously produced after many tedious processes. The use of new compositions has almost eliminated the old processes, yet the methods in general are still in use. Carbon is used for the thousands of cells yearly made. It is consumed by electric-light companies to an immense extent. Its manufacture has become an art. There are experts today that can tell the history of a carbon block, as far as the processes producing it are concerned, with perfect confidence. The use of carbons is extensive and is spreading daily. Carbons are sold that have no right to appear. One company takes a pleasure in making a uniform and satisfactory grade. As in all other cases they have become the far-reaching centre of gravity to the trade and consumers.

MORN.

In the first glimpse of morn we see the future light of our homes. Like a vast wave submerging the city it sweeps from street to street; it filters through the darkness as though it were a black, monstrous, formless thing pierced by living swords. Over all the city and quiet air the mantle of blue extends, until the whirling earth changes her garment for a robe of crimson and glistening gold, and the semi-light glides away like a spectral army with noiseless, hesitating footsteps.

Power Transmission by Ropes.—In a paper on "The Transmission of Power by Ropes and Belts," read before the French Society of Civil Engineers by V. Dubreuil, it is stated that one great advantage possessed by ropes is that cyclical variations in the speed of the driving pulley are "damped" by the ropes, so that the speed of the driven pulley is much more uniform than that of the driver. Ropes are also useful when the two lines of shafting are not perfectly parallel. The velocity of the rope should not be less than about 1,500 feet per minute, nor more than 5,000 feet, while with belts a velocity of as little as 600 feet per minute may be used, but the maximum should not exceed 4,000 feet per minute, above which the centrifugal force prevents the proper adhesion of the belt to the pulley. For great distances between the lines of shafting ropes should be used, although in exceptional cases they may be employed with as little as 12 feet between shaft centres; in general the distance should not be less than 20 feet. Spans of as much as 328 feet have been worked by ropes with only one intermediate support. Under no circumstances should the diameter of the smallest pulley be less than 30 times the diameter of the rope.

(*Continued from page* 298.)

sive or appreciative idea of what advance in this line of work really means, is to compare the situation of today with that, not of a hundred years ago only, but with that of only twelve months ago, and note the contrast.

RAILWAY NOTES.

The rapid growth of trolley roads all over the country has been a source of great surprise to the casual visitor. The towns seem to build themselves around the trolley. and the capitalist has found, in so pliable a system of local transit. a means of investment that appeals at once to his speculative tendencies.

This investment, however, need not partake of the nature of a speculation, but of a positive source of income entirely devoid of the element of chance, if the causes through which *financial leaks* are likely to occur be watched and, should occasion require, be immediately repaired.

The difficulties existing in the management of trolley systems and the mention of those causes which tend to pull down the dividends of a road have been very ably discussed by the members of the Texas Street-Railway Association in the following report :

The third annual meeting of the Texas Street-Railway Association convened at Galveston, on March 18, 1896, with the President, W. H. Sinclair, in the chair. After an opening speech by the president the convention got down to business and began discussion of various subjects, as follows :

Fares :—Whether the use of tickets of any sort should be advised; if a reduced ticket, in what form, and how handled and sold. Only one railway represented sold reduced fares, and none sold children's tickets. The Dallas roads require full fare for all children except babes in arms; others, all children occupying seats.

Employés :—The question of whether time was wasted and accidents added to by not using conductors; cost of a conductor is $547.50 per year; the general length of time of employment is 12 hours, an average pay of $1.55 per day. Some pay by the hour, some by the day and some by the month.

It was generally conceded to be a good plan to increase the pay after certain length of service. One road works its men four days and they are off one; another two days and off one, except for relieving times. Other roads use three men to two cars, one man being a swing run man.

Considerable discussion was had as to what are repairs and what are properly expenses Mr. Hayward, of Houston, submitted a blank specification which was generally approved.

Power :—Only three roads could give definite figures on the cost of power per mile; they were 0177, 0144 and 014. The latter under hired power. One road other than these, although not giving definite figures, must have a lower rate. because they have water-power and pay very little for it.

Considerable discussion was had as to the amount of training a man ought to have in order to save power, and the sort of training.

Hull, Que.—The Hull Electric Company has obtained water-power for the operation of their electric railway and lighting plant It is at Duchene Mills, between the island and Conroy Bro.'s mill. The estimated cost, aside from that of placing dynamos and other electrical machinery, is $25,000. The plant will be operated by five 60-inch special new American turbine water-wheels. At a meeting of the shareholders the following were elected directors : W. J. Conroy, president; R. H. Conroy, Chas. Magee, vice-presidents ; F. A. Magee, James Gibson, J. M. McDougall, Q. C.; E. Seybold, managing director, and Theophile Viau.

THE COMMERCIAL VALUE OF ACETYLENE GAS AS AN ILLUMINANT.

BY LOUIS A. FERGUSON.

(*Continued from page* 279.)

THE results of the tests made at Spray, and before described, show that 8.3 pounds of carbide is produced by each electrical horse-power in one day, or .463 pounds per kilowatt hour; also that the efficiency of production was 58.4 per cent. Experience at Spray shows that the carbons used as electrodes last about seventy hours with the same amount of energy as used in this test. The cost of these carbons is $2.00 each, which approximates six cents per pound, or 18 cents per kilowatt hour. The cost of lime I have put at $5.00 per ton and coke at $2.50 per ton, these figures being about the average prices for these materials of good quality, and considerably less than the actual cost of them at Spray. The question of the cost of electrical energy is the all important one, so that I have taken the Niagara price of $20.00 per electrical horse-power per year of 8,760 hours, considering this to be the lowest commercial price obtainable at the present time and one which offers no question as to its accuracy, it being one which is absolutely tangible. The estimate is further based on the assumption that the carbide plant is to be operated at full load twenty-four hours per day and 365 days each year, so that the actual cost per electrical horse-power of energy consumed may not exceed twenty dollars divided by 8,760, which is .238 cents, or .317 cents per kilowatt hour. With this data as a basis the cost of producing one ton of calcium carbide at Niagara Falls, in a plant having ten 200-kilowatt furnaces producing ten tons of carbide per day, would be as follows :

POWER.

4,320 K. W. hours at .317 cents per K. W. hour		$13.69

MATERIALS.

2,085 pounds of lime at $5.00 per ton		$ 5.21
1,339 pounds of coke at $2.50 per ton		1.67

CARBONS.

Carbons for 4,320 K. W. hours at .18 cents per K. W. hour		$ 7.78

SUPERVISION AND LABOR.

Operating two shifts, 12 hours each.

One superintendent at $5.00	$ 5.00	
One chemist at $4.00	4.00	
Two foremen at $2.50	5.00	
Ten regulating men at $1.00	10.00	
Six furnace men at $1.50	9.00	
Two grinders at $1.50	3.00	
Six laborers handling, grinding and mixing at $1.50	9.00	
	$45.00	
Labor per ton 45 ÷ 10		$ 4.50
Cost of barrels and preparing carbide for shipment		1.00
		$33.85
Interest at six per cent. on $25,000, the investment necessary to erect the factory, furnaces, crushing and mixing machinery, apparatus for handling and regulating	$1,500	

Depreciation on $25,000 at five per cent	1,250	
Taxes at $10.00 per M	250	
Insurance at $3.00 per M	75	
	$3,075	.84
Cost of production at Niagara		$34 69
Freight from Niagara to New York, Philadelphia, Boston or Chicago at 15 cents per C pounds		3 00
		$37 69

This estimate of cost per ton of calcium carbide is intended to represent the cost of manufacture to a large gas company operating in New York, Boston, Philadelphia or Chicago, with its calcium carbide works at Niagara, and whose business would be to produce acetylene from the carbide in the city where the gas is to be used and to distribute it to its customers through its existing mains. It is not intended to represent the cost cleared off its hooks of any corporation or firm whose sole business would be the manufacture of calcium carbide for the market, for to cover that case we must add to the above estimate the cost of general expense, including administration, royalties and selling expenses, which of necessity would be equal to a large percentage of the factory cost as given.

(*To be Continued.*)

Springfield, O., March 23.—Professor William H. Eckert, the well-known inventor, in speaking of the recent publications concerning the Roentgen process, says that his researches are resulting in the discovery of a new or first state of matter, with a positive mechanical law, governing the actions of but seven primary elements of matter, by which nature produces everything in the mineral, vegetable and animal kingdom. These discoveries, he claims, have greater interest to the scientific world and value to the human race than all the combined discoveries of the last century, such as Roentgen's X rays.

He claims that Edison, Rōentgen and Tesla are wasting energy on what is simple when the laws of the seven primary forces of nature are understood. He has discovered that the first state of matter dispenses with the hypothetical ether in space. The second form of the seven elements is the origin of the seven special colors. Space is occupied by the first state of matter, which transmits waves of motion and forms the storehouse from which nature draws its creative supplies. The different ways in which the seven elements combine, produce the differences in ponderable substances. Each has its own crystalline arrangement projecting its co-responding angle of motion to the eye. Those inponderable waves, which produce vision, may be transmitted through other substances to any distance, and so produce a corresponding effect on the eye or the photographic plate.

It is therefore just as practicable to see through a thousand miles of wire as to talk through it. Magnetism, electricity, heat, light, sound and color are all imponderable phenomena, created by the seven elemental energies.

Some things are so simple to certain gifted beings that they are always wondering what men, like Edison, Tesla, Roentgen, etc., are working it. A mind so luminous is being neglected by the present scientific world. We thought the age of deductive philosophy had passed, yet it seems there are still many things to be seen.

Extract from *N. Y. Journal*, May 24, 1896.

THE PATENT OFFICE EXHIBIT.

To ship the exhibit of the U. S. Patent Office of 360 models of electrical inventions, for the Exposition, required 38 cases. They weigh over two tons. Mr. W. A. Megrath, of the Patent Office, has been specially detailed by the Hon. S. T. Fisher, acting patent commissioner, to take charge of the exhibit.

SINGLE-PHASE SELF-STARTING SYNCHRONOUS MOTORS.

BY F. H. LEONARD, JR.

(*Continued from page 287.*)

IF no air is used the blower spills the wind out of its fan and requires only enough power to overcome the friction and maintain the pressure. As fast as the air is used the blower takes a corresponding amount of power, the motor absorbing the current accordingly.

An arrangement for elevator service which is extremely simple has been devised. The constant speed alternating motor, cable drum and gearing are all mounted on a single base casting, in which the respective parts are bolted. There is a pinion on the shaft of the motor which engages two beveled gears, each mounted on a sleeve, which also carries one part of a friction clutch, the two sleeves rotating in opposite directions and the whole being supported by and turning freely on the worm shaft which engages the worm-wheel that turns the cable drum. The other part of each clutch is keyed to the worm shaft. The controller wheel is mounted on an extension, which is cast on the case that entirely encloses the bevel gears and pinion, permitting them to run constantly in oil. This controller wheel is connected to the controller cables or hand ropes which serve to operate the elevator. A pull on the hand rope turns the controller wheel, rotating it through an arc of 60 degrees. This rotation serves, first, to release the brake, on the worm shaft by means of the adjustable link and lever, by depressing the roller which travels over the cam in the controller wheel; at the same time one shipper fork is moved by the connecting rod at its upper end, which is pivoted near the upper rim of the controller wheel far enough to cause one of the clutches to engage its other part on the sleeve attachment to the bevel gear, so as to drive the worm shaft and rotate the cable drum. At the same time the connecting rod attachment to the shipper fork opposite moves across the centre of the controller wheel without producing more than enough movement to take up the lost motion in the clutch parts to which it is attached. Pulling the hand rope in the opposite direction brings the parts back to their original position, disengages the clutch and sets the brake on the worm shaft. Pulling still further in this direction the opposite connecting rod travels so as to move the shipper forks and engages its clutch, turning the hoisting drum in the opposite direction, while the first-mentioned connecting rod moves across the centre without causing any appreciable movement of the shipper fork.

The motor runs continuously in one direction during working hours, and there is no heavy rush of current in starting as with a direct-current series motor, with its tendency to drop the brilliancy of the incandescent lights on the same circuit. Neither is there any necessity for complicated automatic starting rheostats, safety devices and multiplicity of connections; two wires only connect the secondary of the transformer which furnishes the alternating current to the motor. There are many classes of work in connection with which perfect uniformity of speed is of vital importance. To such cases these motors are peculiarly adapted, as an overload of 50 per cent. may be instantly thrown on to these motors and the next instant thrown off without changing the speed in the least; not even causing a variation of a fraction of a revolution.

These motors are suited to any frequency in general use in this country, and are wound for from 140 to 60 complete periods per second, the speed being fixed by the frequency of the generator or circuit to which it is connected. It will no doubt be understood, however, that a motor wound from 140 periods or 16,800 alternations, under which conditions it would run at 1,400 revolutions per minute, would not be suited for use on a 60-period circuit or 7,200 alternations, where the motor would run at 600 revolutions per minute.

All sizes from one horse-power to and including the ten horse-power are wound for 100 to 110-volt secondaries, though the larger sizes are designed for higher potentials, as 200 and 300 volts, and even for direct connection to primaries where proper attendants are in charge, though this would not be safe in general practice where the person dealing with the motor is not fully acquainted with what he is handling.

While this motor was designed for single-phase circuits yet it is obvious that it will work quite as satisfactorily when connected to either leg of a two or three-phase circuit, and where such circuits are loaded with induction motors, a few synchronous motors properly distributed and somewhat over-excited would serve to allay the pernicious effects of the inherent lag or idle current which goes with induction motors, at the same time raising the E. M. F. at the extremities of the line, reducing the drop in the conductors and allowing the generators to do more work, inasmuch as they would not be required to deliver so large a wattless current.

This synchronous motor is also a good rotary transformer and lends itself very conveniently for charging storage batteries and electrolytic work, the alternating current entering at collector rings while direct currents are delivered from the commutator brushes. For laboratory work, and as a piece of apparatus in colleges that teach electric engineering, it is invaluable; for besides the previously mentioned uses it may be driven by direct currents as a series motor; further, it may be run at a constant speed as a direct-current shunt motor, while from the collector rings alternating currents may be taken at any frequency, dependent upon the speed, which can be regulated by resistance in the field or armature circuits; or, belt driven, it may be used as a self-exciting alternator.

(*To be Continued.*)

PRINCIPLES OF DYNAMO DESIGN.

BY

Newton Harrison, E.E.

(*Continued from page* 286.)

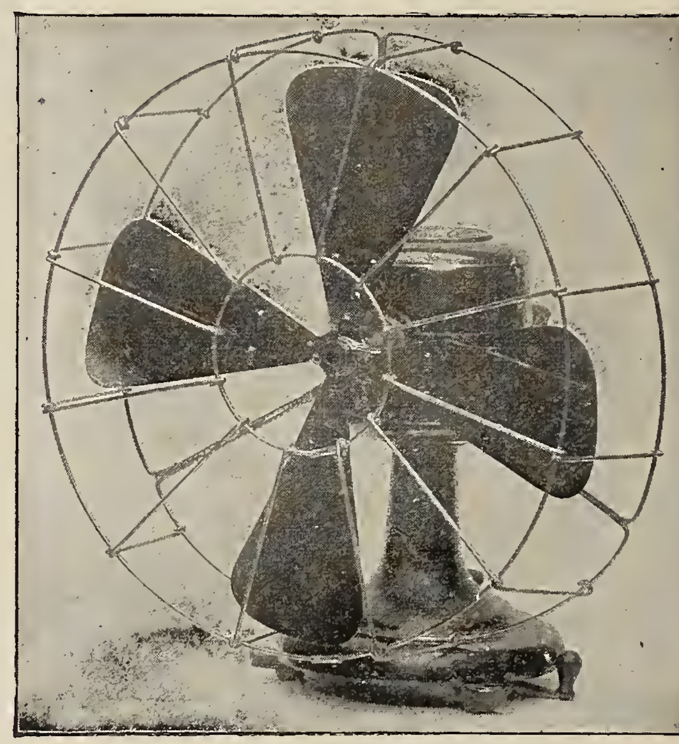
The construction of ventilating apparatus has become quite a study in itself. Of late nearly all hotels, saloons and apartment houses consider such features part of their equipment. The varieties of fans are very great. They are generally classified under two heads:

Pressure Fans.
Exhaust "

It is not difficult to understand the principles on the basis of which fans are selectively used.

Although the subject of design is somewhat different from the subject of ventilation, both are pretty well connected together, as the demands of one influence the design of the other. It is therefore not wrong to consider ventilation for a short while apart from the main subject. A fan is required for the purpose of ventilating or cooling a room. It is very necessary that the air should be set in motion and if possible renewed.

In many cases the atmosphere is simply rotated and no fresh air is admitted of any consequence. Where the room is small and the heat great, the fan will have to be designed for a somewhat higher temperature than usual. A motor working in a high temperature is equivalent to a motor heavily loaded. There are certain distinctions to be drawn between motors running a fan continuously and one that has an intermittent load. A fact, perhaps known to some, is that the fan may not always be a constant load to the motor. A strong breeze will release the fan from much of its work and cause it to rotate with much greater rapidity at times. It is not a difficulty that can be eradicated, but it is at least to be remembered. The position of a fan in a room has much to do with this. It is sometimes best to shut down the fan if this trouble manifests itself. A large ventilator forcing air into a room would have its work greatly decreased if the wind began blowing very hard. The air forced against the blades of the fan would release it considerably and decrease the load. This is satisfactory because the only evil effects following are those due to the changes in load; when the breeze stops, being heavy; otherwise, light. But if the current of air be very strong in the opposite direction the motor must overcome this as well as drive a stream of air forward. One advantage of ventilating apparatus is the fact that the air cools the motor considerably if it is direct-connected to the fan.



ARC IRONCLAD FAN MOTOR.

In the design of a good ventilating motor a constant speed is very desirable. The framework of the motor must be conveniently made so that no difficulty will be experienced in getting it in position readily. The armature should be preferably a Gramme or at least a drum armature of large diameter. The reason for this is, that the fans do not run at a very high speed and are not adapted very well unless by counter-shafting to a large fan. The use of a small diameter drum armature has always been found unsatisfactory for these reasons.

A toothed armature is best, as it allows all the advantages of a good mechanical construction to predominate. Although the ventilating apparatus generally used is not large, in many cases for public places or very large restaurants exhaust fans six or eight feet in diameter are used. It is much better to exhaust the air than to force it in under pressure. By forcing the air into the room a strong draught is created which may be very uncomfortable; it will blow light objects around and cause a disturbance of a most unsatisfactory nature. On the contrary, an exhaust fan need not be used for the purpose of cooling the air, but simply to renew it. To remove unsatisfactory odors and purify the atmosphere, the best method is undoubtedly the exhaust, in many cases.

The speed of a motor is determined by the fan about to be used. As all cases differ from each other, the variations may be traced to these factors:

Diameter of fan.
Pitch of blades.
Speed of blades.

There is every reason to believe that a motor will not burn out if provision be made for these power-consuming factors. A slow-speed motor would be just as useless as a very high-speed motor, if the pitch of the fan-blades was not correct. A fan whose blades are of high pitch requires a great deal of power to drive it. It may be of small diameter even, and the experience would be striking. The volume of air, therefore, is in the main the point of issue. This may increase with either the pitch, diameter or speed, or also diminished. The horse-power of the motor is determined by the volume of air per minute. The speed and pitch of the fan will be effective in producing a given volume of air. This, it must be observed, is not to be produced by a motor either too small or too large, as in either case economy would be unattainable.

(*To be Continued*).

Color of Bodies.—The natural color of bodies results from the fact that one portion of the colored rays contained in white light is absorbed at the surface of the body. If the unabsorbed portion traverses the body, it is colored and transparent; if, on the contrary, it is reflected, it is colored and opaque. In both cases the color results from the constituents that have not been absorbed. Those which reflect or transmit all colors in the proportion in which they exist in the spectrum are white; those which reflect or transmit none are black. Between these two limits there are infinite tints, according to the greater or less extent to which bodies reflect or transmit some colors and absorb others. Thus a body appears yellow because it absorbs all colors with the exception of yellow. In like manner a solution of ammoniacal oxide of copper absorbs preferably the red and yellow rays, transmits the blue rays almost completely, the green and violet less so; hence the light seen through it is blue.

MILWAUKEE, WIS., 1896.

The Fifteenth Annual Meeting of the Association of Railway Telegraph Superintendents will be held at the Hygeia Hotel, Fortress Monroe, Va., at 10 A. M., Wednesday, June 17, 1896.

Several distinguished railroad officials and electricians are expected to be present, some of whom will address the Association on topics of interest to all railway telegraph men. Papers by members will be read and discussed.

The committee on arrangements will issue later a programme covering the three days of the session.

The Pullman Palace Co. advise us that members of our Association paying cash fare for the going trip to Fortress Monroe, in Pullman cars, and *taking receipt therefor*, will, upon presentation of these receipts to Superintendent R. C. Edwards, Thursday A. M., June 18, receive from him trip passes for their return.

It is confidently expected that this meeting will be one of great interest and profit to everyone who attends, and members are urged to be present.

Applicants for membership will be cordially welcome.

Executive Committee:

M. B. LEONARD, president.
J. W. FORTUNE, vice-president.
P. W. DREW, sec'y and treas.

NATIONAL ASSOCIATION OF STATIONARY ENGINEERS.

LOUIS SCHMACHTENBERGER, Corresponding Secretary,
65 West 70th Street.

NEW YORK, May 19, 1896.

TO EDITOR OF ELECTRICAL AGE.

Dear Sir:—Stevenson Association, No. 44, had recently two very interesting lectures on the Evolution of the Arc and Incandescent Lamp, by Mr. W. S. Clarke, of 1476 Lexington avenue, New York. Mr. Clarke is a rising electrician and is possessed of an excellent flow of language and great descriptive power, and never fails to deeply interest his audience. Both lectures were greatly appreciated by the members of No. 44.

Yours fraternally,
LOUIS SCHMACHTENBERGER, Sec.

INQUIRY COLUMN.

In this column we shall endeavor to answer all questions relating to the science of electricity that may arise in the minds of our subscribers.

(*Q.*)—**Batteries for Motor.**

JERSEY CITY, May 28, 1896.

Dear Sir:—Please inform me what primary batteries give the largest output in amperes per cell. I want to use about ¼ H. P. to run a motor and prefer to use 2-volt cells. Please mention output per cell.

Yours sincerely,
JOSEPH MASON NAYLOR.

(*A.*)—The battery giving the greatest output per cell in amperes is the bichromate. It will give a strong current continuously if enough liquid is used per cell and the carbon surface is large. It is the simplest to set up and about the cheapest to run. Use bichromate of soda instead of potash, as it is cheaper, and equally as good as potash. Keep the zincs well amalgamated. A saturated solution of bichromate with 10 per cent. of sulphuric acid will answer the purpose.

(Q) **Nickel Plating.**

SAVANNAH, May 29, 1896.

EDITOR OF ELECTRICAL AGE.

Dear Sir:—I have often wanted to do some good nickel-plating. Can you recommend a solution and battery that will be cheapest and best for the purpose? I have a great many articles I want to plate and hope you will give this your immediate attention.

Yours truly,
JAMES F. HONEY.

(*A.*)—A nickel bath is prepared by dissolving in hot distilled water the double salts of nickel and ammonium. They may be bought at any plater's supply house. Filter the solution. Use one part by weight of salt to ten of water. The bichromate will be good enough for home plating of the Fuller type.

(*Q.*)—**Charging Storage Batteries.**

BOSTON, May 12, 1896.

Dear Editor:—I have made a set of storage batteries; they are all ready for charging. I have electricity in our house; my father has a dynamo in the basement giving 110 volts. My batteries in series will only be able to give at 2 volts per cell 30 volts. How shall I charge them? Kindly let me know at once.

Yours very truly,
ALFRED N. BOUGHTON.

(*A.*)—Take about 10 lamps and connect them in multiple. Use receptacles for this purpose. Connect one end of the wire belonging to the lamps to the dynamo; the other wire to the batteries; then a wire direct from the dynamo to the batteries. Connect batteries in series. See that the positive pole of dynamo connects to the positive plate of battery.

(*Q.*)—**Best Books on Electricity.**

WILMINGTON, May 22, 1896.

Dear Editor:—I make haste to get this letter in, in time. Kindly let me know what books are best for a student whose desire is to learn the subject of electricity thoroughly, I would like to have them without mathematics, if possible. I will be greatly obliged to you if you let me know as soon as possible.

(*A.*)—Elementary Lessons in Electricity and Magnetism is the standard text-book of schools. The Arithmetic of Electricity and Magnetism, by Morrow & Reid, is another simple book for beginners. For popular reading get Electricity in Daily Life.

ROENTGEN RAYS.

Light Waves and Sound Waves—There is an essential difference between the waves supposed to constitute light and those forming sound in air; both must have an origin as centre *within an elastic medium*, but sound arises from vibrations in the air *in the direction* in which the sound wave travels, and not at right angles or transverse to it, as the phenomena of light require. We can easily see that the vibrations forming sound must be longitudinal, or in the direction of the sound ray, from what takes place as a bell is struck, the side of the bell communicating its vibrations to the air in the direction which the sound travels.

The Luminiferous Ether.—Dr. Hook, in his "Micrographia," not only adopts an undulatory theory, but first advances the *doctrine of interference* in light. In order that these vibrations and undulations or waves may exist, it is required that there should be an elastic medium called the *luminiferous ether*. It is supposed to pervade all space, and to be either of different density or of different elasticity within dense bodies to what it is without them, so as to travel through them with diminished velocity.

Magnet Affecting Light.—When gelatinous bodies (like the eyes of fishes) which have dried unequally; when transparent bodies are subject to pressure or flexure; when those crystalline bodies which generally have no double refraction have crystallized irregularly; when glass and crystals are subject to unequal temporary heating or chilling, and when glass is under the action of powerful electromagnets—in these cases the particles of the bodies are in states of restraint, which give rise to small degrees of double refraction.

Phosphorescence.—The property of phosphorescence must be distinguished from combustion, incandescence, the luminosity of insects, etc., by its being derived from the exposure of the phosphorescent body to light only. The existence of this property is shown by light being dispersed around the body, either whilst under illumination, or for some time after the body has been removed into the dark.

Bodies which Phosphoresce.—Many bodies have been found which shine from two to eight seconds after removal from the sunlight into a dark room. Borax amongst salts, cotton, and shells of fish amongst animal subtances, were found to possess this property to a considerable degree.

Phosphorescence and Violet Rays.—It was noted by Morgan that the more refrangible rays, or violet end of the spectrum, were most connected with phosphorescence.

THE WORCESTER POLYTECHNIC INSTITUTE.

It is our pleasure to state that by recent enactment of the State Legislature, 20 new free scholarships in the Worcester Polytechnic Institute become available to the next entering class. This makes forty free scholarships in all, being one for every Senatorial district in the State, in addition to the 25 or 30 free scholarships to which students from Worcester County only are eligible. This institute is gaining national fame by its able work in applied science.

Its many graduates have received a thorough training, which so well equips them for practical life that many have made themselves distinguished in their special vocations.

The courses in engineering are very complete. Shop work adds an element to each, which is invaluable in after life. The course in Electrical Engineering covers the subject very thoroughly. It would be well for those about to enter collegiate life to inquire into the excellent departments of study of the Worcester Polytechnic Institute.

ADDRESS OF PRESIDENT C. H. WILMERDING.

MEMBERS OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION:

Ladies and Gentlemen:

THE National Electric Light Association owes its birth to a meeting of those interested in the problems of electric central station lighting held a little over eleven years ago, on the 25th of February, 1885, at the Grand Pacific Hotel, in Chicago. Many of those who came together at that time are here to-day—a little older, it is true, and a great deal wiser in matters pertaining to the subjects they met to discuss; in fact, if we turn to the records of that first meeting, we can but be struck by what, in the light of our present knowledge, appears to be the lamentable ignorance of those same gentlemen; and yet it must be remembered in their favor and in extenuation that they knew as much as could have been expected of them in those earlier days of electrical development. They meet to-day in their nineteenth convention, and those of you who will follow the proceedings will see that they have improved—it is only fair to give them this opportunity to vindicate themselves—and I think I may add that you will find at the end that the improvement has not been entirely one-sided.

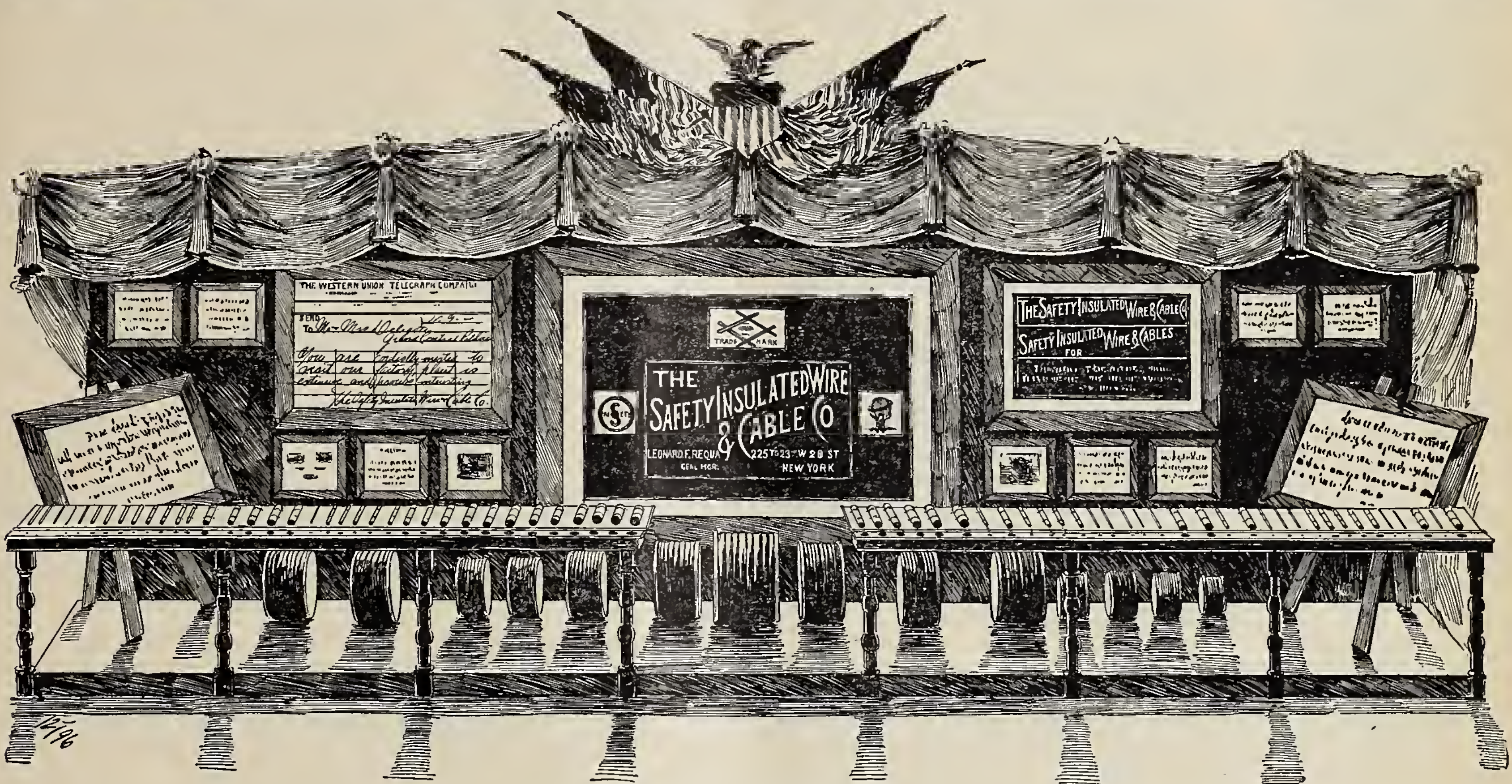
In these few years the central station for the production and dissemination of electric current for lighting and power has practically been developed; it barely existed in those days. It is needless to say that it enjoys a very vigorous and healthy life at the present time. It is, I think, without undue self-congratulation that we can say that the association has contributed its share to this progress, and we, therefore, owe a debt of gratitude to those who met in Chicago, for even if they did know very little about electricity, they foresaw the wisdom of co-operation and the value of the free exchange of thought and ideas which have made the association what it is to-day. The object of any such organization as this is primarily the advancement through mutual intercourse of its individual members, and secondarily, the fostering and protection of their common interests. In both of these fields we can say with some pride that this association has, since its inception, steadily advanced, and with each year of its growth we have seen that it exerted a greater influence; that it afforded a greater opportunity for the acquirement of technical and practical knowledge, and that in proportion as it has become a stronger and more homogeneous body it has grown to be a greater necessity to central station interests. In this twelfth year of its existence, we hope it may keep up with the steady improvement of former years and advance as nearly as possible in lock-step with the progress of electricity itself.

When our fellow-countryman, Benjamin Franklin, flew his silken kite, an event which marks the first step toward present achievements, he drew from the clouds a tiny spark. The spark was then but like the twinkle of a star, billions of miles away. It hinted at the existence of an unexplored world, but so faintly that the most powerful telescope of imagination failed to measure its dimensions or to determine its course. Gradually new facts were added, one by one, concerning this mysterious, distant star; it grew brighter; it was certainly coming nearer and nearer within the reach of man, but it was only a few years ago that it assumed the proportions of a body of the first magnitude; and so rapid has since been its onward progress that to-day that tiny spark has grown to a brilliant midnight sun, dispelling darkness throughout the civilized world. Such has been the meteoric course of the science which brings us here now. What in the days of our childhood was scarcely more than a toy—at best the interesting, the mysterious phenomenon of the scientists' laboratory—is in these

(*Continued on page* 305.)

THE SAFETY INSULATED WIRE AND CABLE CO.

If there is one company that knows what it is about, it is the Safety Insulated Wire and Cable Co. They had an exhibit at the fair that has excelled anything in the vicinity for attractiveness and catchy advertising. Their great at-



SAFETY COMPANY'S EXHIBIT.

traction was a Western Union telegraph blank illuminated by electric lights. Every now and then the words of a message would appear and melt out of sight, one word after the other. The handwriting was the regular quick business style so commonly seen. Also a pair of first-class war vessels, which were equipped throughout with safety wire shown by means of the electric light—seen one minute, invisible the next. The strolling visitor could not help being impressed with the fact that the people in front of him were not letting grass grow under their feet.

The Safety people supplied the exposition company with all the wire used in the building. That in itself is an "Ad" of some consequence. Everybody that passed found it out. The samples of wire shown by the Safety Insulated Wire and Cable Company were beautifully mounted on a large sample board. It was used as a railing, and of course came [illegible]minence at once.

Some[illegible] whispered "that there was no use 'railing' against it" but he was quickly suppressed The cables sold by the Safety Co. are excellent. They showed samples that were exposed, so that the covering could be seen and their nature and quality criticised.

They secured a $400,000 contract from a Philadelphia concern for wire to be placed underground. This is but a bit of the notoriety they have secured; their 800 miles of wire in New York streets might as well be known as well as the fact that when the great ocean grayhound "St. Paul" was stuck on the Jersey coast Safety wire connected her to shore. The Safety people are alive and up-to-date in making their article and selling it, too. They have made up their minds to satisfy the trade on all occasions and to step in whenever the chance offers. Their wire is above suspicion. It is being introduced everywhere with the greatest success.

Columbia, S. C.—The Columbia & Eau Claire Electric Railway Co. got its charter from the Secretary of State and expects to begin the operation of its new line to the Highlands. Directors, F. H. Hyatt, Charles W. McCreery, W. A. Clark, T. T. Moore and others.

(*Continued from Page* 304.)

closing years of the century the mightiest agent known to man. By its means the news of the world is gathered from its four corners in less than a second's time—yesterday it carried the command by which Governor Morton called the wheels of our Exposition into life over six thousand miles, from the Atlantic to the Pacific and again to the Atlantic, at a touch of the finger, and in less than the twinkling of an eye. Through its agency the softest whisper of the human voice is transmitted a thousand leagues, or recorded and preserved for the ears of future generations; the divisions of time are so integrated as to enable the eye to follow in reproduction the continuity of the most rapid motion; night is turned into day, darkness into light; the waste forces of nature are harnessed and wafted like spirits, unseen and instantaneously, over mountains and rivers, miles upon miles, to turn the busy wheels of distant industry; the hidden secrets of nature are laid bare by the ray that pierces dense matter with the ease of a shaft of sunlight travelling through thin air. One miracle has followed another until we can but wonder what apparent impossibilty will be accomplished next. The fables and fairy tales of old pale before the facts of the present day.

The most recent of these triumphs of science, and the one which has attracted the most widespread interest and perhaps promises the greatest results in a scientific way, is the marvelous discovery of Prof Roentgen—the cathode or X ray. Thanks to the courtesy of Dr. Thomas A. Edison, the application of this strange light, the methods employed to obtain sciagraphs and the use of his newly invented fluoroscope, by which one can see as through a stereopticon the bones of one's own anatomy, are graphically shown and explained by the assistants from his laboratory.

Equally new to the world, and first brought forward by another of our distinguished honorary members, Mr. Nikola Tesla, are the beautiful and curious effects in lighting produced by high frequency, high voltage currents, which will be shown by Mr. McFarlan Moore, as he has developed them and applied them to practical use. Mr. Moore, perhaps in a true spirit of prophecy, describes this as the "light of the future."

Still another invention which has seen the light of day since the Columbian Fair, and also owes its origin to the fertile brain of Mr. Tesla, is the oscillator, by means of which unique contrivance much of the machinery now requisite for generating electricity is dispensed with, and current is derived directly from the energy of steam.

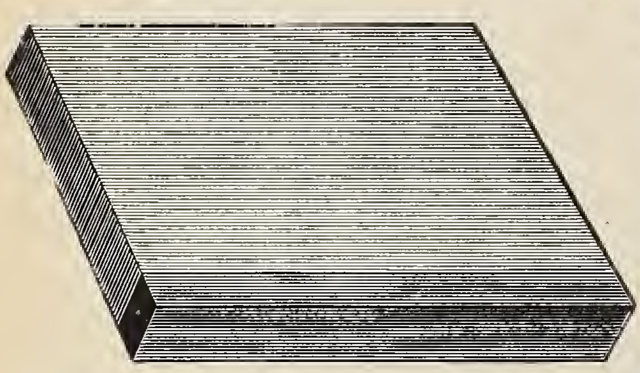
ELECTRICAL EXPOSITION NOTE.

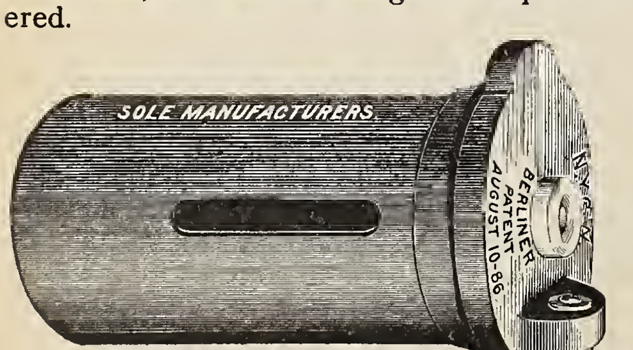
GEO. W. MILLS.

THE successful electrical exhibition held at the Grand Central Palace attracted unusual attention among intelligent New Yorkers. It began under the most flattering conditions and will go down into history as one of the most successful "shows" of the times. The exhibits included everything electrical and afforded a striking presentation of electrical progress from the days of the first crude instruments up to the latest developments of the scientific application of electricity. Six sets of Edison's Roentgen ray apparatus were in evidence, operated by the "wizard's" own men, and there were printing presses run by electricity, all kinds of vehicles operated by electricity, all kinds of electric machinery and all kinds of electric supplies.

J. S. SILVER.

One of the most noteworthy of the miscellaneous exhibits was that made by the New York Carbon Works, manufacturers of granulated carbon and carbon dust, carbon plates, carbon cylinders and motor brushes, who have their offices in this city at No. 41 Cortlandt street (the Taylor Building), and their factory at Newark, N. J. The company occupy a leading position in the electrical field, to which they are justly entitled by virtue of the acknowledged superiority of their high grade productions and the honorable character of their business methods. They were established in 1884, and their record has been one of continuously increasing success. The officers are as follows: J. S. Silver, president; Albert Storer, vice-president; W. H. H. James, secretary and treasurer, and G. W. Mills, general manager. The company make a specialty of the manufacture of motor brushes, which they supply to leading electric railroads everywhere. These brushes are self-lubricating, require no attention and allow reversal of the motor without injury to the brushes or commutator. Where they are used the sparking, heating, humming and scratching so common to ordinary carbon brushes is done away with, and the severest tests have proven their superiority over the copper brushes now generally used. The company manufacture these brushes in three qualities, soft, medium and hard, and of any desired size, so that the range of requirement is fully covered.





Their carbon cylinders and cups for open and closed circuit work are the recognized standard of this country, and have been used by the largest electrical supply houses and manufacturers for years; and their carbon plates, which are made from selected gas retort carbon, are used by all the leading battery manufacturers of the United States. They keep all the standard sizes constantly on hand, and make special shapes and sizes to order at short notice. They supply special mould work of every description, and furnish granulated carbon for porous cup batteries, and selected carbon dust for dry battery purposes, in both large and small quantities.

WM. MILLS.

The company are justly proud of the reputation their goods have gained for uniformity and efficiency, and are on record with the declaration that under no circumstances will they depart from the high standard heretofore undeviatingly maintained in order to compete with inferior productions. Their goods have been and are now selling on their merits, and bear off the palm in any fairly conducted competitive test.

Mr. Geo. W. Mills, general manager of the company, one of the subjects of this sketch, has been connected with the New York Carbon Works for over five years, and under his management the business has been placed on a firm and stable foundation.

Mr. Mills supervised the erection of their handsome booth at the electric show, and was in constant attendance day by day explaining the advantages of their productions and calling particular attention to their new improved self-lubricating carbon motor brushes for which they are having a big sale. They showed over two hundred varieties of battery carbons and carbon specialties, which they are manufacturing at their works in Newark, N. J. This company own the patents of Emil Berliner for making carbons porous and spongy.

Mr. Wm. Mills, whose portrait will be seen in this sketch, is the superintendent of their works in Newark. He is an expert in carbon for all purposes. By his practical knowledge they have brought their carbons to the high grade which the trade certify to in the constant renewal of orders.

Mr. Mills' expert knowledge in carbons is testified to by the vast number of consumers throughout the Uuited States. The excellent facilities which this company have for promptly filling orders and the careful attention to details should be credited to their popular president, John S. Silver. He is well-known in street-railway circles; his remarkable business ability and thorough integrity have made him as well as his carbons a standard worthy of the highest admiration. It gives us great pleasure to reproduce his photograph and mention his relation to the company.

The Worthington Boiler, in complete shape, ready to generate steam, is one of the attractions on the power floor; it is only to be seen to be appreciated.

Goldstein exhibits, in the extreme west end of the power department, by their magnetic influence, draw all the attendance towards them. They have beautified their booth to such an extent that all the visitors migrate that way to see what is going on. They will guarantee to clean your boilers completely with their perfect boiler compound.

Queen & Co., of Philadelphia, had not expected to make an exhibit, but at the last moment they secured space on the X ray floor, where a good general display of their instruments may be seen. Central stations carefully investigate the new arc light photometer and pronounce it one of the necessities of their business.

Only three years have elapsed since the World's Fair at Chicago, in 1893, and yet it can be plainly seen that in the meanwhile a sort of Darwinian evolution has been going on, developing things then unheard of and unknown, though the natural progeny of earlier germs now fructified by the power and genius of the great minds that have fathered them.

New York Notes.

The Climax boiler exhibit at the Electric Show contained the only gold medal received by exhibitors at the late World's Fair, Chicago. Climax people are always right up to date in all they undertake. The Climax boiler is made by the Clanbrock Steam Boiler Works, Brooklyn, N. Y.

Edward A. Barnes and wife came on last week to pay a visit to the Electric Show and are stopping at the Waldorf. They were more than pleased with the attractions at the show and will return home with many pleasant memories. Mr. Barnes is superintendent of the Fort Wayne Electric Corporation's Works in Fort Wayne, Ind.

The services of our old friend, J. A. Hanna, late of the McGuire Mfg. Co., have been secured by the Peckham Motor, Truck and Wheel Co., 26 Cortlandt street. We congratulate both parties interested.

The Great Mogul is the title used on the June calendar blotter just received from the New York and Ohio Co., of Warren, Ohio. It is a 300-candle-power incandescent lamp, with a handsome hood to shade the lamp and to throw all the light downwards. They claim it will replace a so-called 2,000-candle-power arc lamp. They are about right.

New Corporations.

New York City.—The Electric Cure Co. Capital, $10,000. Directors, Wm. S. Frye, J. H. Davis, and W. E. Webster, of New York city.

Plattsburgh, N. Y.—The Plattsburgh Traction Co., to construct a street surface railroad to be operated by electricity, between Bridge street in Plattsburg and the lands of the Hotel Champlain Co. at Bluff Point, about eight miles in length. Capital, $100,000. Directors, Henry M. Pierson, Harry G. Hunkle, M. B. Snevily, of New York city; George M. Cole, of Plattsburgh, and others.

Farmington, Me.—The Farmington Electric Light Company has been organized for the purpose of making, generating, distributing and supplying gas and electricity for lighting, heating, manufacturing and mechanical purposes, and for furnishing electric light and power and for lighting the streets and buildings in the town of Farmington and New Sharon. Capital, $10,000. Pres., Edward S. Dingley; treas., J. P. Flint.

Albany, N. Y.—A novel electrical manufacturing combination called the Walker Company has been formed. J. W. Hinckley, of Poughkeepsie, and others, are interested. Capital, $5,000,000.

Syracuse, N. Y.—The Syracuse Rapid Transit Co. has filed certificates of incorporation. Capital, $4,000,000. Incorporators, Edward T. Perrine and Charles T. Dutton, both of New York, and others.

Telephone Notes.

Rushford, Minn.—A telephone line will be built from Rushford to Highland.

New Portland, Me.—The New Portland and Farmington Telephone Co. has been organized for the purpose of constructing and operating a telephone line from New Portland to Farmington.

Natchez, Miss.—Some of the capitalists of Natchez are considering a plan to connect Fayette and a large section of the territory in that vicinity with Natchez by a telephone system.

Tunkhannock, Pa.—A company has been organized for the purpose of extending a telephone line from Tunkhannock to Centre Moreland, and material has already been procured for its construction.

Possible Contracts.

New York City.—Arthur H. Ely, 56 Wall street, will erect a ten-story brick store and lofts at 37–41 East 18th street, at a cost of $250,000.

New York City.—The work of tearing down the old houses at 141 and 143 Fifth avenue was begun. A nine-story mercantile building for stores and lofts is to be erected on the site. The building will be of brick, iron and stone.

New York City.—Plans are now being prepared for the erection of a mammoth family hotel on the site of Ittner's Villa, Tremont avenue, Tremont.

New York City.—Robert G. Dun, of the firm of R. G. Dun & Co., has filed plans through the firm of Architects George E. Harding and Gooch, 255 Broadway, for the construction of a twenty-three-story brick and iron office building. The building is to cost $1,000,000 and will be erected at 294 Broadway.

Elizabeth, N. J.—A. D. Mulford and others are planning the erection of a family hotel at a cost of $100,000. The structure will be built of brick and stone.

New York City.—A movement is on foot to erect a large downtown hotel in New York City. C. F. Wildey, of the Cosmopolitan Hotel, has organized a syndicate to erect same.

Plans have been completed for the new Mechanics' Bank Building to be erected at Montague and Clinton streets. George L. Morse is the architect; George W. Chauncey, chairman of the Building Committee. The building will cost $200,000, entirely fireproof and ten stories in height.

New York City.—Plans were filed for alterations to Carnegie Music Hall, at Seventh avenue and 57th street, to cost $100,000.

New York City.—The Hebrew Technical School, 34 Stuyvesant street, will erect a five-story brick school and shop at 34 and 36 Stuyvesant street.

Brooklyn, N. Y.—Pioneer Storage Warehouse Company will erect a ten-story fireproof building at Flatbush avenue and Rockwell place, near Fulton street. J. C. Glover and H. C. Carroll, 186 Remsen street, are the architects, and the building will cost about $100,000.

Auburn, N. Y.—At the meeting of the Common Council there was a resolution authorizing the clerk to advertise for sealed proposals for lighting the streets and City Hall by electricity.

Newark, N. J.—The Newark Electric Light and Power Company purchased a large plot of ground in Lakeside avenue, near the Watchung Railroad. The company proposes erecting a model electric lighting plant on its newly acquired property.

Boston, Mass.—Another big office building may soon be erected in Boston. At a recent meeting of the Western Union Telegraph Co., in New York, it was decided to erect a large sixteen-story structure in Boston, provided a permit for the same could be obtained from the city authorities.

New York City.—A meeting of the directors of the Metropolitan Traction Co. was held in the Cable Building and matters relating to the construction of an underground trolley line in Eighth avenue were considered.

The Fastest Steamer Afloat — A new torpedo-boat destroyer called the *Desperate* has just been put through some preliminary trials, and has succeeded in attaining a mean speed on four hours' run on the measured mile of 31.035 knots, or 35¾ statute miles. This extraordinary boat is the latest triumph of Messrs. Thorneycroft & Co., and they have now the credit of producing the fastest steamer in the world. It is interesting to study the following figures as to power, speed and displacement. While running at 31 knots the steamer was very light, having only 15 tons on board. Her full load was 35 tons. For 31 knots the engines developed 5,700 indicated horse-power, making 396 revolutions with steam at 205 lbs. pressure, the vacuum being 25 inches. On the full draught trial the speed was 30.46 knots, the power necessary being greater than on the previous day, the engines running at 406 revolutions, with steam at 210 lbs. pressure and vacuum 24 inches. It will be noticed that with 20 tons additional load the power developed had to be considerably increased, and the speed fell off about half a knot. Messrs. Thorneycroft propose for a 33-knot speed to use five boilers. Many refinements in details of construction and mountings, much attention to trim of vessel and quality of coal, as well as dexterity in management are necessary to bring a boat of this kind up to such a high record of speed. These things are best known to the picked men who are put on board to do the work. We shall know more about the performances of boats of this kind by-and-bye. It may be mentioned that the trials referred to were under the personal observation of Admiralty officials on board.—*Trade Journal Review.*

NEW TELEPHONE COMPANIES.

Jersey City, N. J.—The New York Telegraph and Telephone Construction Co. Capital $100,000. Richard Douglass Kelly, of this city; Merritt S. Middleton, of Point Pleasant, and Phillip Sand, of New York.

Carnegie, Pa.—The Carnegie Telephone Co. Capital $10,000. Promoters, Dr. Charles Willis and Dr. Finley B. McGrew.

ELECTRICAL and STREET RAILWAY PATENTS.

Issued May 12, 1896.

559,913. Alternating-Current System of Distribution. Charles P. Steinmetz, Schenectady, N. Y., assignor to the General Electric Company, of New York. Filed Feb. 5, 1896.

559,939. Electric Cigar-Lighter. William Fisher, Chicago, Ill., assignor to Lynden Evans, same place. Filed Oct. 12, 1895.

559,979. Safety-Fender for Cars. George P. Kato, Jr., Jersey City, N. J. Filed Aug. 10, 1895.

560,006. Dynamo-Electric Machine or Electric Motor. Octave Patin and Léon Levavasseur, Paris, France Filed June 19, 1893.

560,023. Thermostat. Willard G. Day, Baltimore, Md. Filed Jan. 4, 1895.

560,029. Car-Fender. William Grunow, Jr., Bridgeport, Conn., assignor to Zalmon Goodsell, same place. Filed December 12, 1894. Renewed Nov. 4, 1895.

560,030. Car-Fender. Domenico Guarino, New York, N. Y. Filed Oct. 1, 1895.

560,031. Electric Railway. John H. Guest, Boston, Mass. Filed Dec. 3, 1895.

560,035. Electric Regulator. Rudolph M. Hunter, Philadelphia, Pa. Filed May 22, 1894.

560,039. Electric-Arc Lamp. Alvie O. Mackin, Anderson, Ind, assignor of one-half to Warren B. Thomas, Johnstown, Pa. Filed Oct. 3, 1895.

560,043. Door Handle with Electric Alarm. Adrien J. Moulart, Paris, France. Filed July 1, 1895.

560,055. Car-Fender. David Ambrose, New York, N. Y. Filed Aug. 1, 1895.

560,071. Railway-Signal. David C. Stewart, Warren, Ohio. Filed Mar. 9, 1894.

560,075. Car-Fender. William P. Young, Pottstown, Pa. Filed Oct. 15, 1895.

560,076. Electric Programme Clock. Alfredo Antonio Cardoso E. Bastos, Sao Paulo, Brazil. Filed Mar. 20, 1894. Patented in Brazil Nov. 25, 1893, No. 1,664.

560,087. Meter for Alternating Electric Currents. Thomas Duncan, Fort Wayne, Ind. Filed Dec. 21, 1891.

560,093. District-Telegraph Call-Box. William H. Garven, Portland, Oreg. Filed June 19, 1895.

560,096. Electric Call-Bell. Frank C. Jordan, Wadsworth, Ohio. Filed Mar. 20, 1896.

560,097. Trolley-Wire and Trolley Therefor. Herbert R. Keithley, Buffalo, N. Y.

560,098. Trolley-Wire and Trolley Therefor. Herbert R. Keithley, New York, N. Y.

560,102. Automatic Railway Signal System. Jacob W. Lattig, South Bethlehem, Pa. Filed Apr. 10, 1896.

560,128. Fuse Cut-Out. Walter E. Harrington, Philadelphia, Pa., assignor to the Cutter Electrical and Manufacturing Company, Camden, N. J. Filed June 1, 1894.

560,168. Electric-Lamp Socket. Harry W. Leonard, New York, N. Y., assignor to the Edison General Electric Company, same place. Filed June 28, 1890.

The Electrical Age.

Vol. XVII., No. 24. NEW YORK, JUNE 13, 1896. Whole No. 474

CANADIAN ENTERPRISE.

ELECTRIC RAILWAYS.

We are rapidly becoming accustomed to trolley roads; they have become an integral part of a city's equipment. It is not strange that they should take such a hold on the population, as the merits of this system of transit is openly evident. To consider the most striking features in their development is in itself an interesting study. It has enabled the close observer to accurately judge from the sprigs of immaturity whether the blossomed plant will grow healthy or stunted, blossom or quickly decay. The characteristics of an invention or of any combination that has a strong bearing upon sectional growth contains the elements of calculation; the means by which its future, or at least, its present, can be determined. In no field of applied science has the silent applause of the populace been so strongly manifested as in the advent of the trolley.

It combined certain elements in its construction, in the very power applied to it, which took the nation's fancy. We are a trolley-ridden people. To use the energy of a current, invisible and, to a certain extent, inconceivable to the ordinary mind of that time for the propulsion of heavy cars, was to the mass a mystery that banished those of more sacred fame as a mere whisper of old. The trolley has passed through its condition of doubtful growth and approaches in these later days a state of perfection which is yet one far uplifted above crudity, but still possessing undeniable features which bring it to the level of an incomplete and, in some cases, an unreliable propulsive device. The trolley, like other great and extensive systems of locomotion, derived much benefit from the processes through which its half brother, the locomotive, has passed. The matter of road beds and their construction had been definitely settled. There existed no doubt as to the tremendous possibilities arising from the successful introduction of the trolley, and in all the path was paved and well prepared for it. The utility of the trolley is not at present a question that lies in much doubt. There have been signs on all sides of a progressive increase in the life and business of a city utilizing this method of local travel. It has added an element to a city's growth that unexpectedly gave issue to benefits of incalculable value. Suburbs hitherto but slightly occupied, almost primitive in their condition of undisturbed, nature, have been made the home of a vast horde of lower middle class to whom this life means new and powerful incentives to healthy progress. The trolley has been the direct cause of this blending of town and suburb of the city's heart with the country heather and fragrant rose. In spite of municipal objections, the electric railway has risen superior to all obstacles and proven itself with all its deficiencies a much-needed addition, and an element in which resides all future possibilities of rapid transit. It is from this new standpoint a factor of international value, a harbinger of greater possibilities and a mark of enterprise and civic earnestness. If in reviewing the utility of electric roads a comparison were instituted, the difference would not be so striking as to create a violent contrast. The trolley owes its position to a perfect flexibility, an adaptability to almost all the surface conditions of a town or city. It is a simple system to install, and when once operated the plant works with undisturbed smoothness. The coal is centered in one spot, and it is conveniently handled without having to be of the best quality. The other great advantage of such a system is due to its popularity as an adjunct of a large power turbine plant. It is, then, not even necessary to produce power from coal. It is already on tap, only requiring the necessary additions in the shape of proper turbines and dynamos. To enumerate these particular advantages is to refer to the trolley lines fed by Niagara power in and around Niagara City, and its manifold advantages, for the smoke of kindling fires is seldom seen in that town. Even the blacksmith uses the current in his forging operations. There is in the review of such names as Davenport, Daft, Sprague, Edison, and Siemens and Halske, a similar feeling to that excited by a consideration of characters in history, art or sculpture. They are names of men identified with the growth of the trolley and alive to-day, with but few exceptions, to realize the meaning of their own efforts to the country at large. Their work is of a varied nature and was marked by attempts which have characterized this branch of engineering by rapid changes and improvements. The divisions into which electric roads may be placed are in themselves the basis of a long string of inventions. The simple

Trolley,
Battery,
Block,
Conduit

systems have been developed alone, and then in certain cases recombined for the purpose of adding a feature that might make its stay permanent. But the trolley has prevailed against all, and the money spent in the organization and construction of storage battery and block systems useless. But one of them all, at present, shows signs of success—the conduit road.

MONTREAL PARK AND ISLAND RAILWAY.

A. J. CORRIVEAU OF THE MONTREAL PARK RAILWAY.

Princeton, N. J.—M. Taylor Pyne, of New York City, has given to Princeton College the sum of $600,000 for the erection of a library building. In this structure Mr. Pyne proposes to have the headquarters of the New Jersey Historical Society.

Morristown, N. J.—The question of street lighting is being discussed at Morristown.

AN INTERESTING TEST OF A NEW RELAY WATER-WHEEL GOVERNOR.

The government of water-power for electric-railway work has always been considered a very difficult problem even under the most favorable conditions.

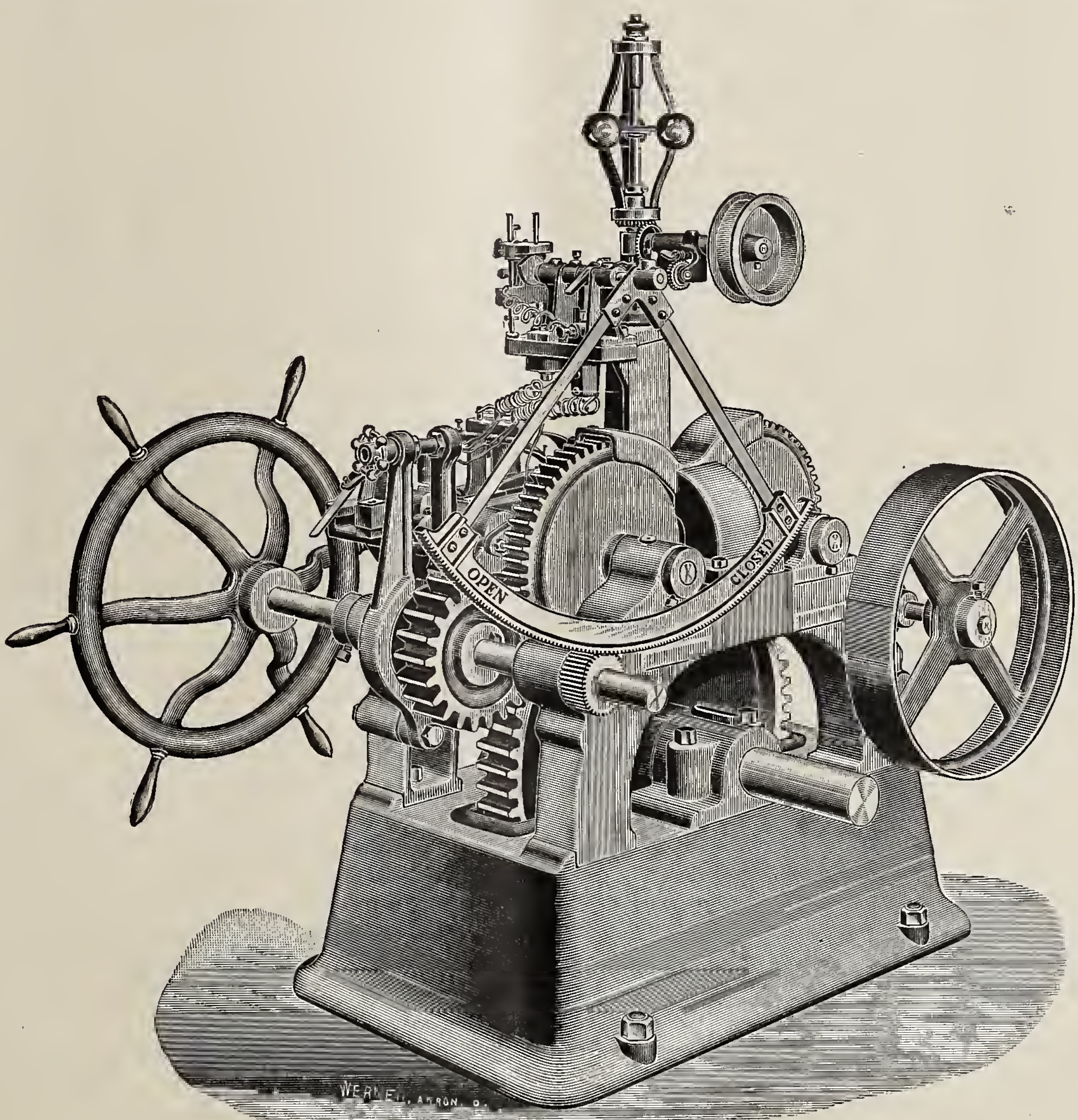
Many power-plant operators, where the changes in load are great and sudden, find their government so uncertain and so near the danger line that it has been said that railways cannot be run successfully by water-power. Again there are plants in which the changes are but a small percentage of the whole power of plant, or if the changes in load are great they may be distributed over such length of time as to allow the power to be readily governed. It is the extreme and sudden changes that cause serious trouble.

In the following test it is intended to show what can be done in the extreme cases, and it was the aim to have the test made under the very worst conditions. The time chosen was during a heavy snow storm, with fully three inches of new snow on the track, and the success in obtaining bad conditions is fully shown by the fact that the circuit breakers went out ten times during a thirty minutes' test. This of course makes instantaneous changes of from full load to no load. A most remarkable point shown, is that in only one case did the speed rise to slightly exceed five per cent. from normal.

The normal voltage was 550 volts, but in no case did the voltage reach 600, and in only one case did it get below 500 volts. These are the extremes, and were due only to instantaneous changes of full load, and the variations in speed were only momentary, as will be noticed by consulting the tabulated test.

The electric railway in question is that of the Citizens' Street Railway Company, Fishkill-on-Hudson, N. Y., connecting with Matteawan and Fishkill villages. The road is operated by the president and general manager, Mr. J. T. Smith with W. E. Havens, supt. There are seven miles of road. The maximum grade in this road is 8½ per cent. There are two portions nearly one-half mile long each, that average about five per cent. grade. There are some short curves and some of them are found on the heavy grades. The main line is giving a ten-minute service, and the suburban line an hourly service. At the time of the test four double-motor cars were in operation, using from 30 to 50 H. P. each. With the permission of Superintendent Havens we will state that one of the cars became short-circuited, which is the direct cause of the extreme variations in the speed during the latter part of the test. This shows, however, more fully the efficiency of the governor under the most adverse conditions.

The power is furnished for this road by The Carroll Electric Co., Matteawan, N. Y.; general manager, Chas. H. Watson, with W. E. Blakely as power-house superintendent. The power is furnished from a pair of 48-inch "Rodney-Hunt" water-wheels, under about 15 feet head of water, and is conveyed by belts to a counter-shaft which in turn drives by belt a General Electric "M. P. 100" generator. (The plant contains a second generator in reserve, like the one mentioned.)



A REPLOGLE GOVERNOR.

A preliminary test showed remarkable results when both generators were at work. But it was thought best to make the test under the worst conditions with one generator only, making it more valuable from a scientific point of view.

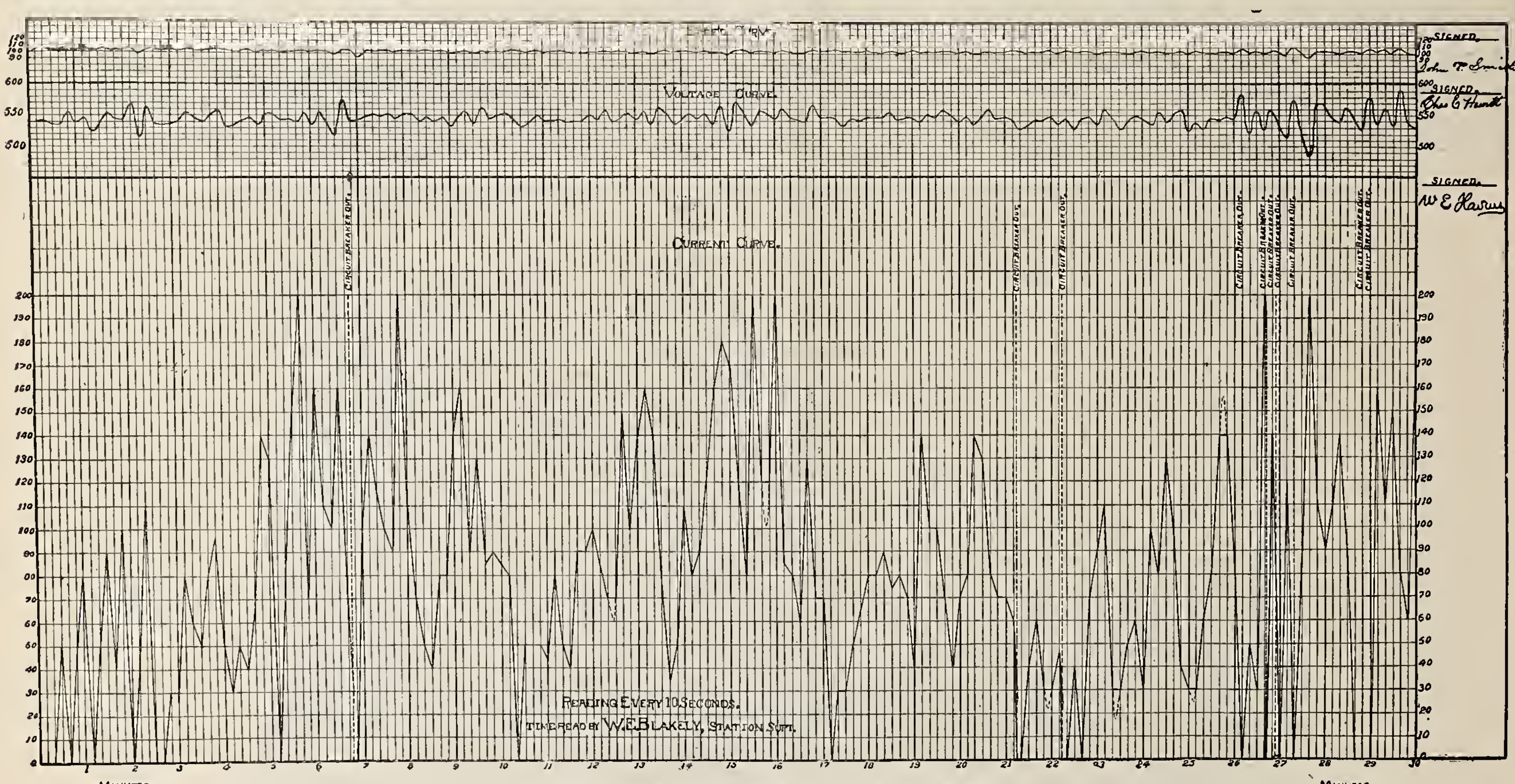
The wheel can be supplemented with a Fishkill-Corliss Engine, which is belted to the same counter-shaft as the water-wheel, but during this test the engine was disconnected, leaving all the power to be furnished by the wheel, making this a safe and reliable sample of results that can be secured under such conditions.

Mr. J. T. Smith, president, read the speeds from a "Schæffer & Budenberg tachometer." Mr. C. E. Hewitt, electrician, read the voltage from a "Weston voltmeter."

Mr. W. E. Havens, superintendent, read the amperes from a General Electric Co. ammeter; and Mr. W. E. Blakely, power-house superintendent, noted the time by tapping a gong at the end of every tenth second, and the end of every minute was noted by two taps of the gong. The readings began at 12:38 P. M. and continued for 30 minutes, until 1:08 P. M., when the papers were signed by their respective readers and committed to the hands of Mr. Hewitt, who has favored us with the tabulation of curves that are used in this paper.

The test was witnessed by Mr. Chas. H. Watson, to whom we are indebted for the opportunity of making these later the reading is no amperes, 540 volts, and 107 revolutions. This is equal to the best engine work. The circuit breaker went out during the 22d and 23d minutes with practically no increase in the speed.

At 26 minutes and 40 seconds the readings are 200 amperes, 529 volts and speed 101. During the following 10 seconds the circuit breaker went out, and at the end of these 10 seconds the readings show 140 amperes, 560 volts and 105 revolutions, normal speed. This is a remarkable showing. The extreme fluctuations are all recorded accurately and were caused by the short-circuited car and the new fallen snow. Preliminary readings under ordinary



TEST OF A NEW RELAY-GOVERNOR.

Matteawan, N.Y. April 7-1896-12-38 noon to 1-08 PM. During a Snow Storm. Carroll Electric Co's Power House, Chas. H. Watson, Mang'r.

readings, also by Mark A. Replogle and others, and the new governor can be found at work by any person desiring to see water-power governed safely, for the extreme conditions that are imposed upon Mr. Watson's power plant.

Referring to the tabulation, it will be noticed that there are three curves. The top one is the speed curve, the middle one the voltage curve, and the bottom one the current curve. It will be noticed that the average or normal speed was 105 revolutions on the wheel shaft, and the average voltage was 550. It will also be noticed that the first reading occurred 10 seconds after the first gong, and the numbers that designate the minutes occur at the bottom of the chart, and at the ends of the minutes numbered. That is, the line that is vertical from number one shows that there were eighty amperes of current, 540 volts pressure, and 103 revolutions on water-wheel shaft at the end of the first minute. At the end of the second minute the chart shows no current, 546 volts and a speed of 104 revolutions of water-wheel shaft, and 20 seconds later there are 110 amperes used, and the voltage has dropped to 516. The reading 10 seconds later shows no current, 564 volts and 107 revolutions. Over one-half of the load has dropped off in 10 seconds, and yet the speed has gone only two revolutions above normal. This is less than two per cent. increase of speed on a 55 per cent. decrease of load.

At the end of the first 10 seconds in the sixth minute there is no current, the voltage is 552, and the speed 104, and 30 seconds later there is full load, 200 amperes, 540 volts, and a speed of 102 revolutions. The following reading 10 seconds later is 70 amperes, 556 volts and 105 revolutions, showing that 65 per cent. of the load dropped off in 10 seconds, and yet the speed did not go above normal.

At six minutes and 45 seconds the circuit breaker went out, dropping the whole load instantly, yet five seconds conditions showed better regulation than that obtained by Corliss engine practice.

The above test shows clearly that water-power government has advanced to such a stage that it is safe and reliable, even under the most severe conditions, and it will therefore be of great interest to street-railway and electric-power operators.

We invite correspondence with parties interested in the government of water-power for all classes of work, but particularly where close regulation is desired, as in pulp, paper and textile mills, as well as for electric light, power, and railway work.

The Replogle Governor Works,
Akron, Ohio.

The Oregon & Forest City Railway, Light & Power Co., Oregon, Mo., is ready for bids on power-house, 60 x 100 feet, to cost not over $1,500 and be equipped with 300 horse-power boilers, one engiue of 150 horse-power, one engine of eighty horse-power, one heater, one pump, one railway generator, eighty kilowatt; one arc-light generator, one incandescent generator, railway wire, one feed wire, two passenger cars, two twenty-five horse-power motors, one freight car, with two fifty horse-power motors; three and three-quarter miles of steel rails, of sixty pounds to the yard, with fishplates, bolts and spikes, ties, poles, etc. Address James E. Cummins, secretary.

The Telephone Construction Company, 35 & 37 Frankfort street, N. Y., make a specialty of building telephone exchanges and construction of telephone lines. Mr. O. W. Forbes, a member of this company, is the practical man having had large experience in telephone construction work. Mr. Forbes has just returned from the West after an extended trip; he has arranged to construct and build several large lines.

THE EVOLUTION OF THE ARC LAMP.

L. H. ROGERS.

(*Continued from page 297.*)

IF this be true, is it not time to consider the question seriously? Are we to give up the question and acknowledge that, hanging on our streets, is the world's best effort for the distribution of light through the medium of the arc lamp?

Is evolution to be the password to progression in all the arts; in fact, in everything except the arc lamp?

To return to the opening sentence of this paper—"For the purpose for which it is intended to be used the arc lamp, as we commonly know it, is mechanically and electrically the poorest designed and constructed piece of mechanism on earth."

I am not here to decry the lamp of any manufacturer. It is, however, pertinent to say that any lamp which will allow the carbons to slip by or wedge, under any circumstances, is *mechanically imperfect*. It is an inherent defect in the lamp, and the damages or outrages should be charged to the manufacturer of the lamp. What mechanism has determined that the proper way to hold two slim, sharply-pointed pencils in a coaxial position is to fasten them rigidly at their extremities, 18 inches distant, and then depend on their sharpened points nosing each other correctly? A very much better way would be to leave the carbon holder loose and free, centing by guiding the carbons near the arc. This would make trimming a very easy matter, and admit of cross-eyed men being employed. On second thought, however, we run immediately into difficulties, for as we cannot change the rate of consumption of the positive carbon, the arc would soon reach one of the guides and burn it away. This would then require a lamp with a stationary arc, and that would require carbons of different diameters—upper and lower—and that would mean a great deal of thinking for the inventor and manufacturer, and so the lamps go out and the station manager, believing that the arc lamp has been fully evoluted, keeps sending his orders to the manufacturer, and the manufacturer will never improve as long as he can fill his orders with old style apparatus.

A sliding contact is a poor arrangement in an arc lamp. It has been tried as thoroughly as any idea ever could be tried. It is the direct cause of the roughness of the rod. The resistance of the contact is too easily increased by the presence of a little dust. The sliding contact in the arc lamp must go.

The carbon rod itself is a troublesome institution. With an annular ring for a clutch it must be kept in a uniform, polished condition, or it will give trouble. It is responsible for the unsightly hideous chimneys, which ought not to be in sight, and yet which cannot be draped. As we are building a new lamp let us dispense with the carbon rod altogether. We can then cut off the chimneys, and shorten up the lamp. Then we can, without much trouble, parallel the carbons with the operating mechanism, and increase the percentage of useful length to total length, to at least 80 per cent. With a short lamp we can make a casing of light cast-iron in such shape as to avoid the necessity of a hood. We can also increase the carbon length, and if we do this, we can choose our own size of carbons—that size for upper which will produce the largest crater, and that size for lower which will best let the light out.

Thus we come back and meet, but overcome, our first difficulty. We construct a focussing lamp, and this leads us to the thought that there is only one correct position for the arc inside the globe anyway, and that the arc *should* be stationary. If we hang the upper carbon on a chain suspended over a shieve, and attach the lower carbon to the lower end of the chain, we can, with proper adjustment, accomplish many things. As the upper carbon feeds downwards as it is being consumed, the chain can be of equal weight, inch for inch therewith. Therefore, when an inch of upper carbon has been consumed, and its weight taken from the cross-head, an inch of chain has been added, and the armature remains in the same plane between the pole-pieces of the magnet as before. This is an absolute necessity where the same difference of potential is required throughout the entire range of burning.

Thus we are not restricted by the weight of the carbon, and can use whatever size is most suitable. It having been demonstrated that with 8, 9, or 10 amperes, 2⅝" carbon will produce a larger crater and give more initial light than any other size, it remains only to determine the length necessary for burning 14 to 16 hours. This length has been found to be 14 inches. With an upper carbon of ⅝x 14 inches, we find that ½x12 negative plain will burn an equal length of time, leaving an equal stub and keep the arc practically in the same position during the entire run. This small lower carbon will let out the intense light in the crater of the upper, the increase of light at 45 degrees being something which would astonish most experimenters.

We must not forget that 320 millions of money is invested in the central stations alone in the United States, simply to get *light*, and more light with the same expenditure of energy should be a welcome statement by those interested.

By quotations from all leading carbon manufacturing companies of the country, the point is discovered that a pair of ⅝x14 and ½x12 carbons is the cheapest possible combination for 14 to 16 hours' burning. Anyone can test this point. It is simply the price of one ⅝x14 plain and one ½x12 plain carbon against three ½x12 plain or $\frac{7}{16}$x12 copper-coated carbons. I have quotations in my pocket which will make a difference of $2.50 per lamp per year, assuming the full number of burning hours nightly, in favor of the ⅝x14 and ½x12 carbons.

Again, a ⅝ upper and ½ lower, loose at the joints and guided near the arc, will absolutely prevent wedging or slipping by, whether the lamp be shunt or differential.

The Direct Cable Company scored another victory yesterday in transmitting to the United Press the name of the winner of the Derby at Epsom Downs, beating all competitors from thirty seconds to ten minutes. The race was finished at 3.27.15 P. M., London time. The bulletin announcing the fact that the Prince of Wales' Persimmon had won was filed with the cable company at 3.27.30, and it was flashed over the English land lines and the cable and repeated to the United Press office in this city instantaneously, the first letters of the word Persimmon being received in this city before the transmission of the full word had been accomplished by the operator at Epsom Downs.

So perfect were the arrangements for the feat made by Superintendent Brown of the Direct Cable Company that there was no perceptible difference in the sending and receiving time, the transmission of the message occupying less than one second.

The work of The United Press in distributing over its telegraphic circuits to the newspapers of this country the announcement of the name of the winner was equally quick, and it is safe to say that before Persimmon had ceased his galloping stride and a blanket had been thrown over him his achievement was known in the office of every newspaper in the United States served with the news dispatches of The United Press.

Contracts have been let for the building of the entire line of the Union Traction Co., from Arlington, N. J., to Hackensack, N. J., and it is expected to be completed and running by September 1.

The officers recently elected for the ensuing year are as follows: H. C. Adams, president; D. A. Pell, vice-president; H. H. Copeland, treasurer; F. Bourne, secretary; C. J. Field, chief engineer.

This road will run north from Arlington, through Kingsland, Lindhurst, Rutherford, East Rutherford, Carlstadt, Woodridge, Hasbrouck Heights, and Lodi township to and in Hackensack.

THE COMMERCIAL VALUE OF ACETYLENE GAS AS AN ILLUMINANT.

BY LOUIS A. FERGUSON.

(*Continued from page* 300.)

LET us then consider the value of acetylene to the gas companies in large cities. In many articles and circulars treating of this question it has been customary to place the actual cost of acetylene as produced from the carbide, taking the factory cost of the carbide as a basis, against the selling price of illuminating gas at $1.00 per thousand cubic feet. This, of course, is not a fair comparison and is very misleading. Believing that the only fair way to consider the relative value of acetylene and water gas is to compare them upon the basis of cost per candle-power hour in the holder, and assuming that the cost of distribution is the same in each case, I will treat the question on that basis.

We have seen from the results of the tests at Spray that for each pound of carbide we obtained 5.24 cubic feet of acetylene, or 10,500 cubic feet per ton; therefore the cost per thousand cubic feet of acetylene would be one-tenth the cost of one ton of calcium carbide. The candle-power of acetylene being placed at 240 for each five cubic feet of gas, and the candle-power of water gas in the large cities at 25 per each five cubic feet of gas, it will be seen that the candle-power of acetylene is ten times that of water gas per thousand cubic feet, and, therefore, the cost of acetylene, giving the same candle-power as water gas, would be equivalent to water gas at a cost per thousand cubic feet equal to 1/100 of the cost per ton of calcium carbide. For example, if the calcium carbide costs the gas company $100 per ton, then the cost of acetylene gas in the holder will be equivalent to 25 candle-power water gas costing one dollar per thousand in the holder.

The present average cost of illuminating gas in the holders of the large gas companies approximates thirty cents per thousand cubic feet, while the cost of acetylene gas in the holder with calcium carbide at $37.69 per ton would be equivalent, light for light, to illuminating gas at $37\frac{7}{10}$ cents per thousand cubic feet, making the cost per candle-power hour of pure acetylene approximately twenty per cent. higher than that of ordinary illuminating gas. If acetylene were mixed with air and distributed, the cost would be less. This has been done in an experimental way, using 60 per cent. acetylene and 40 per cent. air, but the advisability of attempting to distribute such a mixture through a system of mains in a city for commercial use is exceedingly questionable, owing to the risk of the mixing being improperly done and the quantity of acetylene falling to such a percentage as to form an explosive mixture.

It has been suggested that the cost of distribution as well as the cost of mains and maintenance, which constitute a large portion of cost in the lighting industry, might be saved by the use of liquid acetylene, put up in cylinders and delivered to the stores, residences and offices so that the consumer might generate his own gas as required. It appears to the writer that this method is an entirely impracticable and uncommercial one, as there are almost insurmountable objections to be overcome. Neither the average business man or the occupants of a residence wish to be bothered with the care necessarily attendant upon the use of the cylinders of acetylene. It would be necessary either to have two cylinders ready for service or to have a second one placed in service before the first one were exhausted, and in all probability the busy man would find himself in darkness at the time when he most needed the light, owing to the fact that he had neglected to renew his cylinder. The pressure of the gas in these cylinders is from 600 to 700 pounds, so that it is necessary to use a reducing valve which will give a pressure of one ounce. The same valve which is used with the Pintsch system of railway lighting is employed, but this in all probability would not be kept in condition by the ordinary householder and store-keeper, and the consequence would be that the full pressure might be impressed upon the pipes; and in case this were prevented by the use of an auxiliary safety valve, then every failure of the reducing valve would allow all the gas to escape and be lost. The use of acetylene cylinders would increase the danger in case of fire, since the gas would escape should the cylinders become heated and explosions of the mixture of acetylene gas and air would possibly follow. After considering the many inconveniences and dangers in the use of liquid acetylene in the business and residence district of the large cities, it leads the writer to believe that acetylene to be commercially successful must be delivered to the customers in the form of gas through a system of mains, as is done now with ordinary illuminating gas. Liquid acetylene should find a field in the lighting of country estates, railway trains and for use in carriage, bicycle and locomotive head lamps, and in isolated places where distribution by mains is not psssible.

When acetylene was first brought forward to be used commercially it was expected that the gas companies might still maintain their existing gas works and use acetylene to enrich their gas and furnish a 25-candle-power flame as formerly, but at a much less cost. Experiments have shown, however, that although coal gas may be enriched by acetylene, water gas is not susceptible to enrichment by it. Water gas, which is furnished in nearly all the large cities, has little illuminating power of its own, is now treated with petroleum, and it is only when enriched to a certain candle-power that acetylene may be mixed with it without losing its candle-power, so that we cannot, as at first supposed, substitute acetylene for petroleum and use it economically as an enricher of low candle-power water gas.

It has been suggested that the manufacture of calcium carbide might be carried on by the central station electric lighting companies as a by-product, furnishing the energy necessary for its production during the hours of light load upon the lighting system, thus bringing the load curve of the station nearer to a straight line and thereby improving the economy of the station operation. It will be readily seen from the figures given in the estimate of the cost of producing the carbide, that the cost of power is a very important factor, and if we increase the cost given, of twenty dollars per horse-power per year, we will correspondingly increase the cost of the carbide. From experience with the cost of operation of the largest central lighting stations in this country, the writer can safely state that the absolute cost of fuel alone in the most economically operated lighting station of the most modern type of multiple expansion condensing plant averages .3 of one cent per kilowatt hour, or approximately $20 per horse-power per year continuous service, while the total cost of generation in the station would average over double that amount. In the average of the large central stations the generating cost at the switchboard, without distribution and general expenses, approximates one cent per kilowatt hour, which is about $65 per horse-power per year, and in the smaller stations using steam, double that amount.

(*To be Continued.*)

ALBANY, N. Y.—Sealed proposals indorsed with the title of work to which they relate, with the name and residence of the proposer, will be received by the Board of Contract and Apportionment, at the office of said board in the City Hall, June 15, at 11 A. M., for lighting the city of Albany by electric arc lights and furnishing current for operating elevators in and for lighting certain buildings by arc or incandescent lights, or both, and for the production and transmission of electric current for commercial light, heat and power, in the said city of Albany, for the period between June 21, 1896 and June 21, 1901. Thos. J. Lanahan, clerk.

YORKVILLE, S. C.—W. B. Moore has applied for a franchise for telephone system.

The Electrical Age.

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CONTENTS.

A CROWDED PROFESSION.

There have been remarks passed by many that might be deemed incompetent to judge, yet who have said "this profession is crowded." It is not difficult to understand the meaning of their words, for they imply that which to a casual observer seems but likely, and to the struggling and ambitious exponent absolutely true.

A crowded profession, we beg to observe, is one in which conpetition is keen and the market overstocked with men whose inclinations and abilities have unfortunately thrust them together to battle for individual success with the same weapons. It tones a profession to have it over-crowded. We think it only then becomes entitled to the name.

If a profession originally lucrative becomes surcharged with men of ability, their attainments are certainly wasted. Their time has been spent in training for a race in which only those gifted with supernal swiftness can win. Is, then, a profession overcrowded if the condition of things is different from this? We think not. Numbers usually dominate a crowd; it is this element of quantity which determines the nature of the struggle in many cases, but not in those particular departments of applied science where the trained intellect is weighed against hundreds of but superficial education and untutored mind. There is strength in numbers such that we cannot remain ignorant of their presence.

There is also a greater, more exalted and more irresistible power in the attitude of a well educated and thoroughly experienced man towards a mob, even though they be the aspirants for an equal position and their cry is fierce with the mockery of a sham ambition.

RAPID TRANSIT.

Greater New York is a large city. There are many reasons to believe that it will not become smaller. If the size of the city today is a fair measure of its rate of increase, in 1900 there will be at least 3,600,000 population, and continuing on the same basis in 1906, only ten years from date, at least 4,000,000 people will choke up the public thoroughfares and cars in their efforts to reach their work in the morning and their homes at night. There is not a shadow on this city's map which marks the beginning of any serious change in assistance of the general cause. It is not that the clamors are not loud enough, nor the city government on tiptoes with anxiety to please the public; but no moves other than those investing in authority men of incompetent minds and heavy dignity that will not be moved. If the people desire that which is but right in the eyes of man and law, there is never much delay about getting it. The case at hand is one of parallel conditions; movement must be more rapid in this city. It has been promised, yet it is slow in coming. Truly large bodies move slowly, and the municipal inertia in this case has been entirely overcome; but there still remains the selection of a body of able and active men. What would be the direct outcome of rapid action? A transformation of these roads from end to end into electric railways.

There would be a complete and efficient system of transference from the upper portion of the city to the Atlantic Ocean.

At this time of dead circulation it would put thousands of men into positions and renew a little the life and activity of old.

AERIAL NAVIGATION.

The flights of the imagination are at present much greater than those ever achieved by the daring aeronaut.

Vessels that travel through the air are at present being made by Professor Langley, and he promises to soon be the centre of an admiring audience. There is every reason to believe that he has not been spending his time in vain. If the problem so gradually developing under his careful attention becomes a department of practical use, there will be a new epoch in history that is greater than the past in its far-spreading possibilities. Today the more sober minded deliver no orations on the subject of air ships.

They are too content with what we have to cry for more. Yet upon their opinion, when the first practical demonstration is made, we may form some estimate of the value and limitations of this new piece of mechanism. A beginner learning to practice man-flight would not be distinguishable from one in a somewhat inebriated condition. If the results of accidents are as slight as they are to our friends of the flowing bowl when practising gyrations on the sidewalk or around lamp-posts, we have nothing to fear from their ready adoption and immediate use.

Edward S. Adams, of the Ideal Rail Bond Co., Torrington, Conn., and electric railway contractor, has installed a short section of the Murphy-Pierce Underground Electric Railway System at Westport, Conn. The section is daily in operation on the Westport and Naugatuck Railway and gives good satisfaction.

New York City.—W. A. Cables, 68 Broad street, is preparing plans for the erection of a seven-story brick club house for the New York Athletic Club, Sixth avenue and 55th street, at 59th street and Sixth avenue, at a cost of $490,500.

INCANDESCENT LIGHTING.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

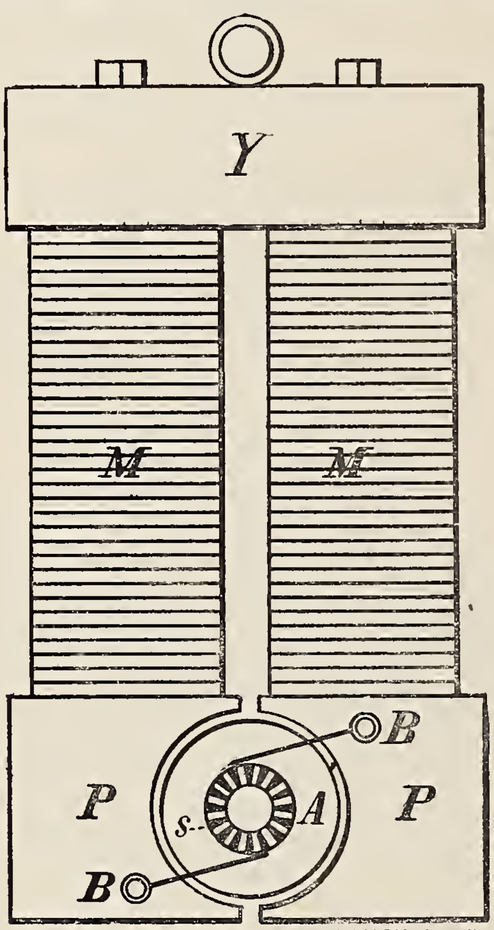
BY NEWTON HARRISON, E. E.

The history of electric lighting is not very old. Its different branches have developed to such an extent that some of the heaviest investments of this country are made in electric light plants. The electric light systems of this country may be divided up into two general branches

Incandescent Lighting.
Arc "

Under the heading of the first we are prepared to consider the development and present condition of incandescent light systems.

Kinds of Lighting.—The lighting of incandescent lamps effected either by continuous or alternating current. An incandescent lamp only calls for a certain pressure and current; when these are supplied the lamps at once become normally bright and the problem of incandescent lighting, as far as the light is concerned, is complete. There are, however, certain stringent reasons for observing snch limits as are imposed by circumstances, and which prevent



PARTS OF DYNAMO.

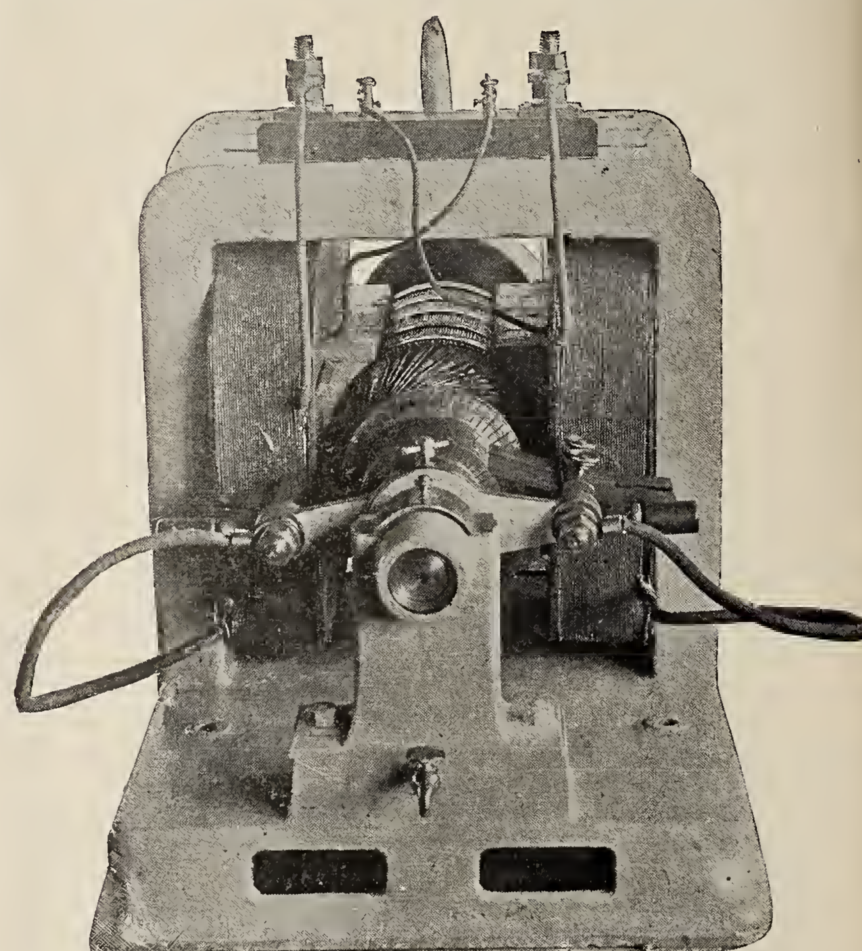
Y	Yoke
M M	Magnets
P P	Poles
B B	Brushes
S	Segments
A	Armature

the attainment of more than a limited light without extraordinary expense. That to which reference is made is the line circuits which carry the current, and which by their arrangement practically gives the system of lighting its name. The success of incandescent lighting depends entirely upon the size, length and support of the line as well as the nature of the dynamo and its additional attachments. The most common system of incandescent lighting known is the Edison. There is in this system certain features which have made it the superior of all others. The reason for this is due to the fact that all the wiring represents a network of squares, arranged in such a manner that one point is at the same pressure practically as any other. The secret, therefore, of successful incandescent lighting is the power of retaining a uniform voltage at all points.

Basis of Lighting System.—Any wiring system which will allow a uniform pressure to prevail throughout is valuable in two respects.

(a) Lamps are saved.
(b) Light is constant.

Under the conditions mentioned the long life of a lamp is assured. There is no greater cause of breakage in lamps than the rising or fluctuating pressure in the lamps. Again, from a purely commercial standpoint, the constancy of the light is so important that unless some means is taken to keep it constant, customers cannot be retained and the damage caused by this double difficulty becomes irreparable.



MODERN DYNAMO.

Function of the dynamo.—To keep the pressure constant in the line the dynamo itself must preserve a uniformity of pressure, or at least within very slight variations. The line depends upon the dynamo, but by means of an ingenious arrangement the dynamo can be also made to depend upon the line. By the two affecting each other we have a system sensitive to outside changes. Compound winding enables us to retain the pressure about constant, or at least to raise or lower it when so desired. This at once brings us to a consideration of the cause of such changes.

Regulation.—The dynamo would not require any extra device if the load upon it were constant, but the continual changes affect the dynamo as follows: When the dynamo is supplying 110 volts and a load of lamps are thrown on, the pressure may fall to 105 volts, due to the

drop in line,
armature reaction,
drop in armature.

Conversely, if the dynamo is laboring under full load and the lamps to a large extent are removed, the pressure will rise from the point it is at and perhaps cause serious injury to the remaining lamps. A regulating device is therefore necessary when circumstances cause such rapid changes as these. The device used is in itself simple enough.

Compound Coil.—A rise or fall in volts is due to the conditions enumerated: a loss of volts in the armature, a loss in the line and armature reaction. These three factors pull down the voltage considerably, and their combined effect is very noticeable with each increase in the number of lights.

To compensate for this loss the dynamo is made sensitive to the changes of load in a very simple manner. A coil is wound around the magnets of the dynamo of large enough wire to carry the current of the line; when the current in the line increases the ampere turns due to this winding increase also, and the dynamo has its pressure increased because the ampere turns have strengthened the field.

If these changes are automatic the dynamo will adjust its potential to the number of lamps and always be high enough to keep them at normal candle-power. The ease with which this arrangement works is surprising; it is in popular use in every isolated as well as central station plant.

The success of incandescent lighting depends upon a wiring system that causes as little loss as possible with the greatest possible variations in current.

The Edison network is the nearest approach to perfection of anything we have. It consists in the main of three parallel webs of wire; between each two adjacent webs there is 110 volts pressure, and between the two most apart, the first and third, 220 volts. The economy of saving one wire and yet having two lighting circuits that are independent, yet in close combination, is obvious. The two outer circuits, between which there is always 220 volts, are greatly used for motors. When the same number of lamps exist on each side of the middle web of wire the system is said to be balanced. The web-like formation is due to the fact that the wire is distributed through streets, which give it the shape of a netting with square meshes, each mesh including one block.

ADDRESS OF PRESIDENT C. H. WILMERDING.

(*Concluded from Page 305.*)

Although the mere transmission of current over long distances is not absolutely new in the sense that the expression must be taken in speaking of things electrical, for it dates back three or four years, yet all the features of the great example of such transmission shown here are individually novel, and the exhibit as a whole may be classified as one of the most significant of all. The generators producing the current at Niagara, as well as the turbine that actuates them, are the largest that have yet been built and successfully operated, and the two-phase winding of the former represents the latest advance in the construction of dynamos for the distribution of power. The line carrying the energy to this city traverses a distance of 462 miles, which is 347 miles longer than the celebrated Frankfort transmission, the longest hitherto attempted. These successful accomplishment of this feat is an indication of great future possibilities in the utilization of natural advantages for the supply of power over wide areas, and at the same time adds a further argument in favor of the rapidly growing tendency towards unification and centralization of generating plants.

A reference to those more strictly scientific advances in electricity leads to the consideration of its growth commercially. Figures are certainly the most convincing expression of the measure of achievement in this direction, and the following facts will carry with them their own conclusions:

About seventeen years ago the first central station was established; at present there are two thousand, five hundred electric light companies in the United States, and about two hundred municipal plants. These central stations represent an invested capital of three hundred millions. There are, in addition, about seven thousand, five hundred isolated plants, which have required the expenditure of two hundred millions more. An idea of the capacity of these ten thousand installations may be formed when it is known that there are produced daily for their use from fifty thousand to seventy-five thousand incandescent lamps; that the annual consumption of carbons in arc lamps is two hundred millions, and that five hundred thousand stationary electric motors are operated by the current which they generate.

The electric railway is of still more recent birth, dating back but ten years, and yet at the present time there are no less than nine hundred such roads in this country using eleven thousand miles of track, operating twenty-five thousand cars and involving an investment of about seven hundred and fifty million dollars, and this investment is increasing annually at the rate of one hundred millions for new roads and new equipment. While these are large figures, they do not at all represent the total capital employed in electrical industries. The manufacturers of the apparatus and supplies used to carry on this enormous business, and the dealers who handle them, have at stake probably a sum sufficient to build and equip all the central station plants in the country; and if the auxiliary enterprises, such as those of the producers of copper, the makers of boilers, the engine and car builders, fixture manufacturers, glass workers and a score of others, who depend in a large degree, and in some cases, exclusively, upon the electrical trade are considered, the grand total would reach a sum that any country might be proud of as a national debt.

This astounding growth affords a striking example of American enterprise as compared with that of the Old World. Against nine hundred electric railways in this country there are less than one hundred in all Europe; and as to electric lighting, the output of a single company in New York, or of a single company in Chicago, is greater than the combined output of all the stations in the brilliant city of Paris.

The short period since our last meeting has in itself marked an epoch of the greatest importance in electrical engineering. The Niagara Falls power plant has been completed and put into successful operation. The first elevated electric railway, the Metropolitan, of Chicago, has been opened for public travel and has already demonstrated that such a road can be operated at about one-half the cost of a steam road, and making it merely a question of time, and a short one at that, before all elevated trains must be propelled by the same cleanly and economical means.

The first powerful electric locomotives of the Baltimore and Ohio Railroad have been put into regular service in the Baltimore tunnel, drawing the heaviest trains and furnishing an example which other railway companies are already preparing to follow. This is undoubtedly the first step toward a general revolution in the methods of transportation which will result not only in greater comfort and better service to the public, but in such a saving to the companies themselves as will place many a road now on the verge of bankruptcy on a prosperous and dividend paying basis.

I am glad to be able to say that, while everything else electrical has been forging ahead, the National Electric Light Association has not been standing still. The report which will be submitted by the Committee on Rules for Safe Wiring and the Committee on Data will show that they have accomplished much valuable work during the past year. The progress which has been made by the former committee toward bringing about the general adoption of a national code of rules for electrical installation is especially gratifying, and we may at last hope that this much to be desired and long deferred result of their labors may soon be attained. We have all suffered from the lack of fixed standards governing electrical construction and from the arbitrary rulings of self-constituted authorities on this very important subject, and the establishment of a board composed of competent and representative men whose rules will be consistent and, as far as possible, permanent, is one of the greatest of our needs, the realization of which should be one of the first aims of the Association.

The report, also, of the Finance Committee will be found interesting and extremely satisfactory, showing as it does that our treasury is in a better condition than ever before.

We have been particularly fortunate in securing papers to be read before this convention upon subjects which are timely and of special interest to central station men; and I desire to take this opportunity to thank the gentlemen who have prepared them and who will read them, for their willing co-operation with the officers of the association in their efforts to make this meeting a successful and instructive one.

I trust, gentlemen of the association, that you will all co-operate toward this result, at least to the extent of a regular attendance at our sessions, resisting, while the convention lasts, if not longer, all the subtle temptations and seductive allurements of this fine city of Greater New York.

INQUIRY COLUMN.

In this column we shall endeavor to answer all questions relating to the science of electricity that may arise in the minds of our subscribers.

(*Q.*) **Thermo Piles**

Baltimore, May 28, 1896.

To the Editor of the Electrical Age.

Dear Sir:—Your Inquiry column has been giving me much pleasure and information thus far. Will you kindly add to the past good work by letting me know how a thermo battery is made an . why it acts as it does; and, if not asking too much, why it is not used in place of dynamos?

Yours respectfully,
Alfred N. Nichols.

(*A.*)—A thermo battery consists of two pieces of metal, as antimony and bismuth, joined together and heated at the junction. A current flows from one metal to the other. A succession of these little jointed pieces will give a strong current in series. They are not used because they deteriorate rapidly. The current is due to the difference in temperature between each end.

(*Q.*) **Turns on an Armature.**

New Orleans, May 20, 1896.

To the Electrical Age.

Dear Sir:—Your kindess in placing the Inquiry Column at the disposal of readers prompts me to take advantage of it at present by asking the following question: Can the speed of an armature limit its turns or does the current? I am not well acquainted with the subject and would like to be enlightened.

Yours sincerely,
Oliver Hays.

(*A.*) The speed of an armature limits nothing. The current fixes the size of wire to be used; the number of turns, the length. The space between the armature core and field can only be filled and the work is over. There is none other than a given volume of copper to be wound. It may be in few turns or in many turns, large size or small size, as the case may be.

Columbus, O.—Bids will be received June 25 for the heating and electrical engineering work necessary at the Masillon State Hospital. Plans prepared by Yost & Packard, Columbus. This work will include engines, dynamos, motors, electric wiring to connect the dynamos with the buildings, the wiring of the buildings, etc., complete. The right is reserved to reject any or all bids. Samuel J. McMahon, president; A. B. Richardson, secretary.

Detroit, Mich.—Sealed proposals will be received June 5, for furnishing to the public lighting committee the ofllowing machinery and supplies: 100 direct-current arc lamps, 14,000 feet of lead-covered cable, two cylinder compound non-condensing steam-engines, two direct-current four-pole arc lighting dynamos, 180,000 feet of insulated copper wire for overhead lines, in accordance with the specifications on file in the office of the Public Light Commission. Will F. Conant, secretary.

SOLUTION OF THE MUNICIPAL STREET RAILWAY PROBLEM.

ELECTRICITY is indisputably the most efficient propelling force for urban railway service; therefore the sole issue is as to the best method to be employed in its transmission from the power house to the moving car.

In considering the several methods which have been evolved by the electrician, we find them to be divisible into four generic classes:

First. The omnipresent, but obnoxious overhead "trolley." This may be termed the "overhead contact" system.

Second. The recently developed open conduit system. This may be termed the "underground contact" system.

Third. The storage battery system. This may be termed the "automobile" or "no contact" system.

Fourth. The variously designated "third rail," "sectional conductor," "electro-magnetic" or "automatic switch" system. This may be termed the "surface contact" system.

Thus we have delivery made by contact with the supply wires from the only available points, viz: "overhead," "underground," and on the "surface." As these points are natural limitations, and as the storage battery plan may, for obvious reasons, be left out of consideration, we need but to decide upon the respective merits of the three contact methods, and if we shall ascertain that all three are alike safe and practicable, we have but to consider the question of costs.

COSTS.

The overhead system, even for the best construction, is very cheap, ranging from $25,000 to $50,000, per mile of double track equipment, but its use upon the streets of most cities is frowned upon, and in many, absolutely prohibited.

The underground, on the other hand, is extravagantly expensive, ranging from $100,000 to $300,000, per mile, according to the sub-surface conditions. While, therefore, it is ideal in that respect in which the overhead fails, it, in turn is barred by its great cost. The investment would bankrupt a large percentage of our city roads.

The surface system, costing only from $50,000 to $75,000 per mile, and realizing the ideal even more fully than the underground, would therefore appear to be the coveted alternative. Its cost is determined solely by the grade of work done, being entirely independent of sub-surface conditions—that is to say, it can be applied to Broadway with its labyrinth of subterranean obstructions as cheaply as to Lenox Avenue, or other streets possessing like virginal subsoil conditions.

From the foregoing, it will be readily perceived why so many more or less ambitious attempts at solving the surface contact problem have been made. It is not, however, so apparent why a problem in itself essentially simple, not transgressing any electrical or mechanical law, and withal, so strenuously pursued, should yet prove so baffling as to defy all attempts at its solution for a period of nearly fifteen years.

To answer such a question intelligently and with accuracy is, nine times out of ten, the equivalent of its solution, and just this is what happened to Messrs. Johnson and Lundell, who began investigating the subject more than three years since. That they have solved the problem; how it has been done, and with what degree of thoroughness, is the subject of the demonstration now being made by the Johnson-Lundell Electric Company of this city.

DESCRIPTION.

The electric current is transmitted from the power house through an underground, hermetically sealed, and highly insulated conductor. This wire parallels the road throughout its length, but is normally *out of electric connection* with any part thereof. A series of magnetic switches are placed in hermetically sealed boxes at intervals of 16 feet along the entire line; a double series of contact points are set in the pavement of the roadway between the track rails. These switches are primarily actuated by a current transmitted to them by contact between the moving car and the contact points. They, in turn, transmit the power current from the buried conductor to the moving car through the medium of the same contact points. It is thus apparent that these switches must remain closed and the point remain alive so long as the car is drawing current from the conductor—that is to say, so long as the contact between the car and point remains unbroken. It will also be apparent that, inasmuch as it is the contact between the car and the street point that keeps the switch closed and the point alive, the severance of this contact by the progress of the car must open the switch and the point must become "dead" and harmless.

This, in simple language, is a sufficient description of the essential parts of the system, and from this description it will be readily apprehended, as we have before stated, that there is no organic law barring its successful issue, and yet it has lain dormant for many years, save only where here and there an occasional spasmodic effort has been made to reduce it to practice.

From the foregoing description it is apparent that the success or failure of such a system must be dependent upon the infallibility or fallibility of the switches. Their failure to connect would mean a failure of current supply and a consequent *dead* car—not a serious matter. Their failure to disconnect would mean a "live" point and a consequent *dead* animal, which would be fatal to success.

As the axiom, that all automatic devices will fail at times, is one that rightfully governs the minds of practical men in considering their utility, they naturally inquire as to the consequences of such failure, and if they shall perchance be serious, the device is promptly discarded. This has been the experience of every inventor who has hitherto essayed the task of solving the surface contact problem, and the system itself has by this process come to be so generally discountenanced that it is only with reluctance that railway managers consent to even superficially examine any new stage of its development. Nevertheless, the inherent simplicity of the system continues to so force itself upon the minds of practical electricians and engineers that we now find a number of them coincidently giving serious thought to the problem. At first blush, the mere demand for infallibility in the switch would seem to relegate the undertaking to the limbo of "Perpetual Motion, "Elixir of Life," "Philosopher's Stone" and other vain and foolish pursuits; but, upon a closer analysis of its several functional duties, we discover that *infallibility* is a pre-requisite in but one of them, viz: the act of "letting go." In illustration: Suppose it should fail to take hold, that is no more imperative than that a cable grip should infallibly act. When, however, it has taken hold, then the act of letting go must be absolute. Is infallibility in this respect among the unattainable things? It was the conviction of the inventors of the present system, Messrs. Edward H. Johnson and Robert Lundell, that it was not. They have, in consequence, given the subject over three years of almost continuous study, and the object of the present demonstration, on West 34th street, is to offer proof to the railway manager that their efforts have been attended with practical results.

The underlying principle embodied in the work may be best expressed by an analogy.

The shadow cast by a street car inevitably follows the car. The movement of the car is not infallible, but the moving of the shadow in obedience to the movement of the car most certainly is. Other conditions, such as the absence of the sun, etc., may prevent the appearance of a shadow, but if it appears it must follow the movement of the car which casts it.

OUR ANALOGY.

The shadow is the electric current drawn to the surface *by virtue of the presence of the car.* Let the car progress and our shadow must inevitably follow and disappear. As in the sun shadow, other causes, such in this instance as a broken wire or an imperfect contact may operate to prevent its appearance, but if it shall appear, the law which determines its disappearance, when properly applied, is as fundamental and as infallible as is that which governs the sun shadow.

Practically the sole point to be determined by the investigator is as to whether the laws of electricity and mechanics have been so applied as to justify the above analogy.

To this inquiry a cordial invitation is extended all interested to visit the plant now in daily operation on West 34th street, between 10th avenue and the North River.

BOOK REVIEWS.

An excellent addition to the electro-technical literature of the day has been made by Geo. H. Kimber. His book on "Electric Wiring Specifications" contains a complete exposition of the details of wiring for incandescent lamps. Electrical contractors will find it a great help to them in their daily work, and architects, a means of checking the specifications handed in by those bidding for a contract. The experience of the writer and his simple style will make the book prove doubly acceptable. We heartily recommend it to our readers.

A book entitled "Press Working of Metals" has passed into our hands. Oberlin Smith, the writer, has doubtless had a wide experience with dies and presses. The book is written in clear and pleasing English. The details of die work and the early history of the first metal workers is ably reviewed. Tubal-Cain has not been forgotten in the author's opening pages. The development of the art from almost prehistoric times until the present day is strongly and concisely set forth. It is amazing to thus consider the scope of the work. Tubal Cain would have shuddered had he seen the vast machinery set in motion by his first and most primitive inception. The processes through which a piece of metal is passed and the ingenuity and brains expended to construct machines that will stamp it into a given form are well explained in Mr. Smith's interesting volume. There are innumerable details to be attended to and a host of factors requiring the closest consideration. It seems as if the author had used considerable care in arranging the different departments of his subject. It is one of close detail and a thorough grasp could only be obtained by an intimate experience in all its varied branches. In this respect we congratulate the author on his success. He undoubtedly possesses the happy facility of being able to communicate his ideas without too much circumlocution, and he has adapted his language to the layman as well as the technical reader. The book will surely succeed.

"The Magnetic Circuit," written by Dr. H. Du Bois, is an interesting change from the customary and well-trodden paths. It is an advanced work on the subject, requiring a thorough knowledge of the calculus for its complete comprehension. The student will find it a very interesting volume, and its purely technical character enable him to view several departments of the subject in a new light. The author is more than well read; he is one that has drunk deep from the well of knowledge. The theoretical, in its purest sense, is contained in the first part of the book and the applications in the second. The work of Frölich and Hopkinson is discussed and the leakage of a frame carefully treated. It will prove an excellent volume to the electrical engineer and electro-physicist. It is, of course, impossible to deviate much from Hopkinson's treatment of the magnetic circuit with success when any practical cases arise; yet the writer, in chapter V, departs from all previous methods in developing the idea of a toroid. The reader capable of appreciating the contents of the "Magnetic Circuit" will form a high and lasting estimate of the writer's great ability.

NEWPORT, KY.—A large plant will be erected by the Cincinnati, Newport and Covington Street Car Co. The plant will include entire equipments of the very latest machinery of all kinds for street railway companies. It is said that the entire plant will cost $1,000,000 when completed.

RAILWAY NOTES.

(*Concluded from Page 300.*)

Car Wheels :—Various makes and styles of car wheels were discussed pro and con, and there seemed to be no unanimity of opinion. It was conceded that the cost of the wheel was not the principal item, but the cost of taking them off and putting them on, and the taking of the cars out of service. It was therefore argued that the best wheel possible should be obtained. It was found that the soft cast shoe was generally used and recommended, though some had the cast and wrought mixed.

Ties :—Cost of ties was found to run from 25 to 55 cents delivered. Cypress, long leaf pine and oak. The cypress for damp soil was found to have long life, but the other should be treated. In treating ties Mr. Drake urged that the ends should not be covered or painted, as that would prevent the sap from running out in the process of curing, and fermentation and internal decay would result. A white oak tie was thought about the best.

Litigation and Accidents :—The cost ran from $500 to $2,500 per annum, exclusive of attorneys' fees, which average about $1,200. It is the general opinion that about 75 per cent. of the amount of damages paid were wrong, and the judgments were brought about by general feeling against corporations and controversion of facts by the plaintiffs.

Methods of Increasing Revenue :—Discussion under this head covered a very wide range; one instance was given where an $80,000 park had brought in $30,000 per annum increased revenue at a small additional expense. Another instance was given where a negro park cost about $3,500, and paid for itself many times during the season.

Mr. Hayward : "I find it is absolutely necessary to study the people closely before presenting them an attraction."

Under general discussion : It is found that where a band had been successful in one place, in another it was an absolute failure, no matter how good the music. It is found that people will not pay a fare, and then pay admission, to any appreciable extent.

Mr. Drake, of Austin : "We tried to give good entertainments and charge a small admission, but found it was not patronized; we then gave very ordinary entertainments free, and had to turn people away." Mr. Drake believes in an amusement circuit. Mr. Hendricks found that a negro park paid, and that band concerts took very well.

Mr. Wakefield : "We find that in Dallas the factory man is the one who patronizes the cheaper entertainments, and we have not enough of this class to make it pay. Wealthier people want attractions that cost more than the increase in business warrants."

Mr. Urie : "We find it profitable to keep in with the base-ball people; they are well patronized in Galveston.

On the question of appointing a committee on summer attractions, no action was taken."

Insurance Committee was made permanent, and president and secretary were added to it in advisory capacity. W. H. Sinclare, of Galveston, was elected president and Carl F. Drake, of Austin, vice-president; C. L. Wakefield, of Dallas, secretary and treasurer. These, with A. H. Hayward, of Houston, and Geo. B. Hendricks, of Ft. Worth, form a directory of five.

The next meeting will be held at Austin, on the third Wednesday in March, 1897.

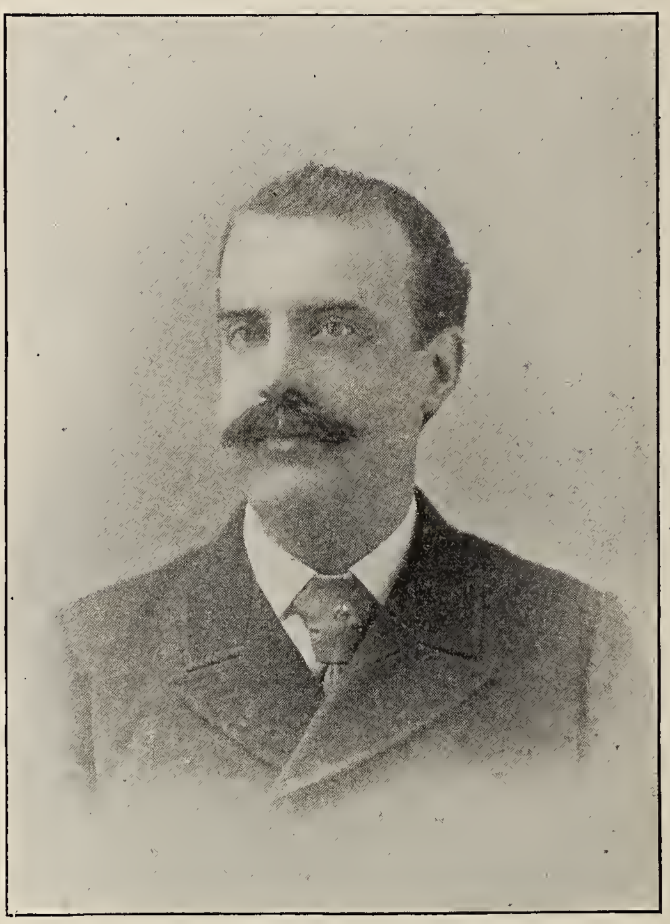
Harrisburg, Pa.—The Citizens' Street Railway Co., of Lackawanna County, was chartered at Harrisburg. Capital, $200,000. To build a line through the principal streets of Scranton and Dunmere, a distance of thirty miles. Directors : William L. Connell, Plummer Page, Charles H. S. Schadt, Patrick J. Horan and Henry H. Archer, of Scranton.

Knoxville, Tenn.—The Mutual Light and Power Co. has been incorporated by J. B. Harrison, A. B. Schelding, A. McMillan, D. M. Haynes and J. L. Davis.

CONVENTION OF RAILWAY TELEGRAPH SUPERINTENDENTS.

EVERY year the above association meets at some place agreeable to its members and, if possible, new to all. This year their annual reunion will take place at Fortress Monroe, Va., a most delightful spot, rich in historical reminiscences and glowing with warm Southern characteristics. The convention will be held at the Hygeia Hotel, spacious and comfortably equipped with the conveniences that make one regret the day of departure.

The association have always found these meetings a source of great enjoyment ; they are not devoted entirely to pleasure, but to more serious work of great mutual benefit.



M. B. LEONARD, PRES.

Papers are read and discussed that cover subjects of considerable importance. It is in this respect the drawing card of the convention. The election of officers is also an important mission of these conventions. Last year the president elected was M. B. Leonard, of the Chesapeake and Ohio Road ; Vice-President, J. W. Fortune, Grand Trunk Railway ; Secretary and Treasurer, P. W. Drew, of the Wisconsin Central. Many eminent electricians take part in the reunions of this association, and points of deep interest are discussed with all the vim and vigor for which electrical meetings are well noted.

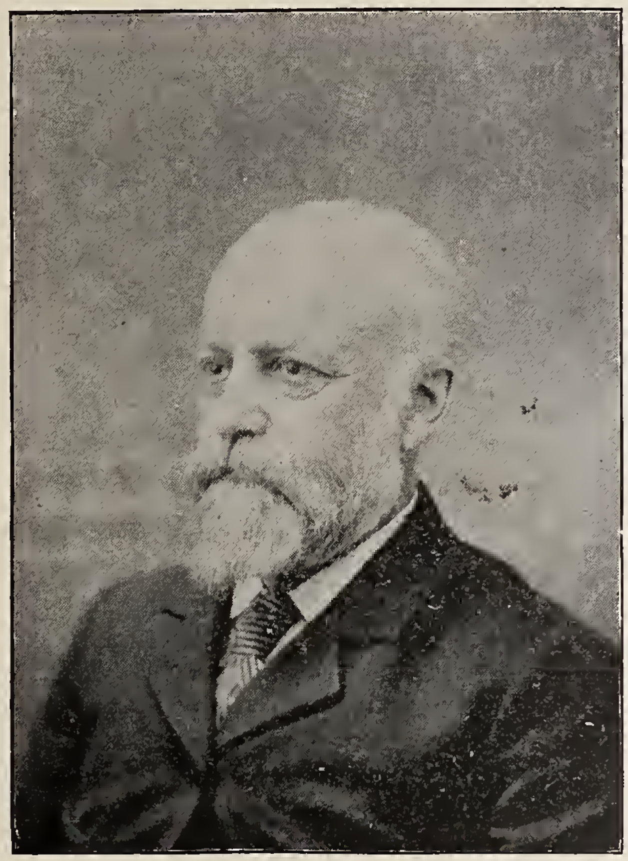
The ex-president of the association is Mr. Oscar C. Greene, superintendent of the Northern Pacific Railroad Co.; his *regime* lasted from 1894–95, when he was succeeded by President M. B. Leonard, who in company with Messrs. Fortune and Drew completes the new party in office.

It would be difficult to find a company of more happy and amiable gentlemen than those composing the association. Each is full of experiences that are novel to his neighbor and thus provides a subject for conversation that is at all times a powerful incentive to the best of fellowship. They exemplify a new phase of the trite saying, "A fellow feeling makes us wondrous wise."

A strong affinity exists between the members, which conduces to their betterment and direct advantage.

The rehearsal of old-fashioned practices never enters their minds ; the papers are always crisp and bright, and backed up by men that only remark upon their own intimate experiences. Fortress Monroe will be the centre of a pleasing assemblage.

The Hygeia Hotel will have its vaults ring with the acclamations of enthusiastic toasters. The superintendents of the railway telegraph systems do not signalize their



P. W. DREW, SEC'Y & TREAS.

convention meetings by a mortal silence, but with the striking indications of a congeniality that makes its memory a happiness and its future a pleasure that is to be.

LYNN, MASS., June 8, 1896.

EDITOR THE ELECTRICAL AGE,
New York City, N. Y.

Dear Sir:—In the number for May 30 of your valuable paper there appeared a description of a large spark coil, in regard to which I wish to make a few remarks.

The coil described is undoubtedly a fair specimen of its kind, being probably constructed according to well-known methods. Modern methods of construction, radically different from those generally employed, make it, however, possible to obtain results as to length of spark, such as have been quoted in your article, with very much less material and without requiring any exceptional skill on the part of the builder.

A twelve-inch spark coil which was recently designed by Prof. Elihu Thomson for the commercial testing of Crookes' tubes had a secondary of only two coils, both weighing together but 35 pounds. The wire was moreover partly number 30 and 32 Am. G., with a single silk covering. The coil gave sparks 14 inches long between terminals, which sparks were thick and flaming, which characteristic was due to the large size of wire employed.

Another nominally six-inch coil, giving 8½-inch spark between balls, had a secondary coil of only 17 pounds of number 34 single, silk-covered wire.

Coils built according to Prof. Thomson's design will shortly be on the market for commercial utilization of the Roentgen rays, and are, as far as is known to the writer, the smallest and lightest coils ever produced for a given output. I use the word output not in the sense of length of spark alone, since it is well known that a very long spark may be so thin and weak as to be practically energyless.

Yours truly,
H. LEMP.

DUNKIRK, IND.—The Dunkirk Electric Light and Power Co. has been incorporated. Capital, $20,000.

A NEW METHOD OF STUDYING THE LIGHT OF ALTERNATING ARC LAMPS.

A paper presented at the 104th Meeting of the American Institute of Electrical Engineers, New York, March 25, 1896.

BY WILLIAM L. PUFFER.

(*Continued from page 158.*)

The disk was held in place by a frictional clamp disk on the shaft. A graduation and reference mark served to measure angular change of disk on shaft, and therefore of slots with reference to the pole-pieces or alternation of the current.

The arc to be tested was put in a boxing to keep away air from the currents close behind the disk, and a camera with a roll holder in front of the disk. With this arrangement the arc as seen was perfectly steady at any part of the wave that corresponded to the position of the disk on the shaft, and as the process of stopping, setting and starting the disk was very rapid, the roll holder being in meantime turned, many pictures could be taken in a very few minutes.

Generally it was not necessary to take more than twelve exposures in order to get a series showing clearly the changes in light intensities during a single phase.

We found that it was about as instructive to watch the appearance of the arc on the ground glass of the camera, and far more beautiful. In this way we examined both the effect produced in the arc by change in the voltage of the circuit, the current being kept constant by alteration of the resistance.

For example, with 500 volts, and a large non-inductive resistance in series with the arc, it was plainly evident that the current wave was approximately sinusoidal, as the time of extinction of the current, as indicated by the blue band of the arc proper, was very short, and the rise and fall of the current gradual and with no irregularities. This is to be expected, as the back E. M. F. of the arc is small compared to the voltage of the generator, and the circuit as a whole is non-inductive.

The opposite condition was realized by using a lower E. M. F. and regulating by a reactive coil. The time of no current was longer, and the current appeared to jump to its maximum in an exceedingly small angular time. In this case the arc was not steady, showing clearly to the eye that the succeeding waves of current were not alike either in form or current value, and also that the angle of lag was constantly changing. This fact has always prevented an accurate plotting of wave forms by the instantaneous contact method, and although known to exist, was never before actually seen.

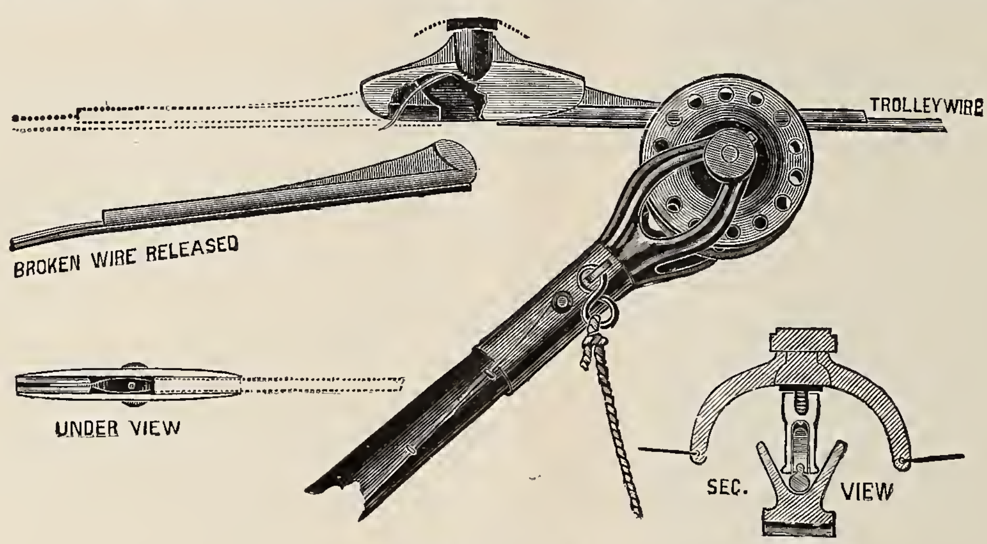
A very pretty double arc was arranged by using three carbons and wiring two circuits, each with current regulators, in such a way that the arc was the common junction, and one carbon was of one polarity, while the other two were of opposite polarity. With wire resistances in each side, there was nothing peculiar to be noted other than the effects of the junction of two currents, but when the resistance in one circuit was gradually cut out, and equivalent inductance cut in, there was at once visible evidence of the lag of the current, together with the change of shape of the wave and the unsteadiness before noted. Owing to the long time of no current in the inductive side there were times when even with considerable lag there were actually no visible traces of current between either points. This effect was dependent on adjustment of current strength and inductance as well as voltage. The sequence of currents and polarity in this arc was most beautifully brought out when the disk was disengaged from the shaft, and driven by the little motor at a rate very slightly less than the dynamo.

We found that work in the immediate vicinity of the dynamo was not very desirable, owing to air currents and excessive vibration, so we arranged a combination of motors that will produce at any distance from the dynamo all the desired results.

A NEW SAFETY HANGER.

A safety invention has recently been brought out and patented by Mr. A. E. Hutchins, of Detroit, which is well calculated and adapted to satisfy the demands of the public for greater safety and protectiom from overhead trolley wires, and which will enable trolley companies to increase the electric potential of their wires—which is an advantage to them on long-distance lines—and by the use of safety hanger-ears or supports, entirely relieves it of its dangerous aspect.

This Safety Hanger is in general outline similar to the common hanger-ear in general use, but is composed of three engaging parts on a main stem or hanger having an interior chamber into which slide or engage its two hanger-ears. These ears clutch or grasp the trolley wire (of interval lengths) and rely upon the pulling or strain of the suspended wire to keep the ears of the Safety Hanger engaged in electrical contact within the recess or chamber of supporting part.



SAFETY HANGER.

But if any part of the suspended wire becomes broken, instead of falling or hanging down to the ground—a live, dangerous wire to imperil life and blockade the traffic in the street—it simply has unhooked itself from the line by its terminal ears sliding back out of the chamber or hanger into which it was engaged ; thus the affected section, falling prostrate to the ground, it does not endanger life or obstruct travel. It is obvious that the engaging parts of the Safety Hanger are well protected from dust and action of the weather, and having two surfaces (twin oblique ledges) against which the enlarged and oblique (and hooked-like) ears engage into, provide the greatest strength and largest amount of contact surface within the smallest compass, so that the Safety Hanger is comparatively light and cheap. The sectional view in cut shows the manner of suspending a Safety Hanger by a double pull-off style of insulator suspended by span wires. A sectional view of trolley wheel is shown as passing in under a Safety Hanger, touching both hanger and trolley wire. By the use of this safety device the inventor not only claims for it its safety features provided, but that there is a great saving to trolley companies in preventing their trolley wires from becoming annealed in case of breaking and relieves from danger of being pulled down by getting entangled with a passing car. Also, the broken line is quicker and more easily repaired and with less expense and trouble.

CONTINUED FROM PAGE 321.

A very nicely balanced brass disk with four radial slots in it was attached to the armature shaft of a Holtzer-Cabot synchronous induction motor of eight poles. The pulley of this motor could be driven by a light belt from a self-starting induction motor of the same make, which is, however, not quite synchronous under load. By trial the two pulleys are wound with rubber tape until their ratio is such that the brass disk will be uniformly driven at a speed a trifle above synchronism, and the arc light can be seen through the slots to pass through the alternation at a desirable rate.

By a single movement of a switch the non-synchronous motor is cut out and the synchronous cut into circuit, when the armature drops into step with the dynamo, and the arc is instantly seen as fixed, the belt is thrown off or left on, as desired. These armatures may be on the same shaft, if necessary. The synchronous motor does not stand on its base, but rests on the turned outside of its bearings in pillow blocks, which are attached to a suitable base frame.

Concentric with the shaft and firmly attached to the motor is a brass gear, six inches in diameter and on it a graduated circle. On a lever pivoted so as to be thrown to or from the motor gear is a small spur gear with a milled head for turning.

Turning this head will evidently cause the motor to slowly rotate about its axle, and as the armature must be in step with the dynamo, and as the turning of the motor changes the position of a given pole-piece relatively to the arc light, it follows that any part of the alternation of current in the arc may be seen on the screen, and as the motor has eight poles, a quarter turn or 90 degrees on the graduated circle corresponds to a complete cycle in the arc.

The picture of the arc can then be photographed, measured, or in any way studied at leisure in any phase relation, as, for example, when the top carbon is positive, or when there is no arc at all and only dull red carbon points visible.

In this way we have seen single arcs of high and low E. M. F., long and short double arcs, arcs with much inductance in circuit, Jablochkoff candles, arc between a ring and a point within, the spinning arc between the ends of a carbon cylinder and a concentric carbon within, with a magnetizing coil around the inner carbon and the like.

One of the most beautiful arcs investigated by us visually and photographically was a rotary arc made by the use of three carbons in the same plane, at angles of 120 degrees apart and wired up as the junction point of an external Y load on a 500-volt 60-cycle three-phase generator. Non-inductive resistance was used in the circuit, and the current used in one leg of the Y was 10 or 15 amperes.

Twelve photographs were taken at equal intervals of 30 degrees in an alternation of the current in one wire. Fig. 1 shows very clearly the relation of the current waves from the different carbon points, and the curved, fan-shaped figure indicates the position and direction of the bluish arc at the corresponding angle. The base of the fan rests on a positive carbon which has a white-hot crater and all the appearance of the positive carbon of a direct current arc, while the tip of the fan rests on the white spot at the end of a negative carbon.

(*To be Continued.*)

New York City.—The Central Syndicate Building Co., of New York, will erect a fifteen-story office building at Broadway and Pearl street, at a cost of $800,000.

New York Notes.

I take pleasure in informing you that on and after this date Messrs. Stanley & Patterson, of 32 and 34 Frankfort street, New York, will act as my sole selling agents in the United states for Fleming's Woven Wire Dynamo Brushes.

With increased facilities for manufacturing, there will be no delay in the future in filling your esteemed orders for any size of brush, or any quantities that you may require.

Thanking you in advance for a continuance of your favors,

I remain very truly yours,
W. W. Fleming,
Patentee and Sole Manufacturer.

Six finely finished ironclad fan motors were presented to the following gentlemen:

Governor Morton.

Dr. Chauncey M. Depew.

Frank M. Hawley, president of the Niagara Construction Company.

Gen'l T. T. Eckert, president of the Western Union Telegraph Co.

Col. A. B. Chandler.

Edward Adams, banker.

Mr. C. O. Baker, Jr. had engraved on two silver plates attached to each motor the name of the recipient with the following inscription:

"This Globe Ironclad Motor was first operated in New York City by direct current generated at Niagara Falls, June 1, 1896."

On the opposite side is the other plate which reads: "Electric power transmitted over Western Union wires 264 miles, May 4, 1896."

It is to the credit of the Globe Ironclad Motor people of 39 Cortlandt street, N. Y., that their motors were the first operated in New York City by direct-current generated at Niagara Falls, June 1, 1896. This is an honor that will be handed down to posterity.

New Corporations.

Macon, Ga.—The Macon and Birmingham Railway Co. was organized. F. M. Edwards, of Boston, is president; E. C. Parsons, of Boston, secretary, and Julian R. Lane, Macon, general manager.

Harrisburg, Pa.—The Blakely Rapid Transit Street Railway Co. Capital, $24,000. Directors: Daniel Daris, Peckville; O. W. Williams, W. W. Watkins and W. G. Robertson, of Dunmore.

OUR NATION'S HISTORY AND SONG, WITH THE CAMPAIGN SONGS OUR FATHERS SUNG.

BY JOSEPH M. CLARY, A. B. L., L. B.

This book presents the history of the United States in a way entirely new and fascinating. No other book or author has ever attempted to show the song side of our history. There has been a constant current of rich song flowing more or less steadily through all periods of our remarkable national life. But our historians so far have omitted to show this current of song. The present author has undertaken to round out our history by adding this important and pleasing element.

This book is handsomely printed on good paper and contains 480 large pages. It is published in two editions; paper at 50 cents, and cloth at one dollar. Either edition will be mailed to any address on receipt of price. Special terms to dealers, agents and newspaper publishers. Chas. H. Kerr & Co., 56 Fifth avenue, Chicago.

Telephone Notes.

Macomb, Ill.—It is understood that J. E. Hall will construct a telephone line between this city and Macomb. The line will be built without a bonus being asked from either place.

Belmont, N. Y.—Belmont is to have a telephone line. All the public buildings and business places will be connected.

Bellevue, O.—The committee of the council appointed to investigate the matter of telephone franchises reported in favor of granting a franchise to D. Calhoun, of this city.

Gadsden, Ala.—A new telephone exchange will be constructed by the Bell Telephone Co.

Jasper, Ala.—The Jasper Telephone Exchange is in the market for an equipment.

Possible Contracts.

New York City.—The trustees of Columbia College will erect a four-story basement and attic college building on 116th street to 120th street, Amsterdam avenue and Boulevard, at a cost of $400,000.

New Orleans, La.—The Canal and Claiborne Street Railroad Co. has completed the arrangements for the location of their power house on the river front. Specifications are now being sent out for bids. Office, 6 Camp street. B. J. De Grange, secretary.

Henry C. Jones, 26 Commerce street, Montgomery, Ala., wants to correspond with contractors in regard to grading and laying track; also, will want to figure on approximate cost of equipment.

QUEEN STILL RULES.

At a meeting of the Board of Directors of Queen & Co., incorporated, the following gentlemen were elected officers of the company: J. G. Gray, president; S. L. Fox, vice-president; J. M. Hazel, secretary and treasurer.

Queen & Co., Incorporated.

There was a happy gathering of business and professional men at the Manufacturers' Club last night, the assembly being made up of the stockholders and creditors of the well-known house of Queen & Co., dealers in optical and scientific instruments. The meeting was held as a testimonial to John G. Gray, a member of the company, who two years ago was made its assignee, when a depression in business caused an assignment to be made.

So well did Mr. Gray handle the assets of the company that he paid the creditors in full, and the estate was reassigned to the company with a handsome surplus exceeding $200,000.

Last evening Mr. Gray was presented with a Scotch edition of the Encyclopedia Britannica, the speech being made by A. G. Elliot. Addresses were made by Mr. Gray, William H. Rhawn, Professor Houston, Hampton L. Corson, and Samuel L. Fox. Among those present were Geo. I. Bodine, Samuel J. Magargee, Alexander C. Wood, Edward I. Bacon, Henry H. Sheip, Chas. Levis, Dr. Sweet, Dr. Veasey and Dr. Thorington, Joel Cook and Alan H. Reed.

After reading telegrams of congratulation and extending personal thanks to Mr. Gray and the other members of the company, the guests were invited to partake of a collation.

NEW TELEPHONE COMPANIES.

San Antonio, Tex.—The Postal Telegraph Cable Co. Capital, $300,000; to build, construct, operate, maintain, acquire, purchase, sell, lease, rent or otherwise secure or dispose of a system of telegraph line or lines in the state of Texas. Incorporators, George B. Durham, of Lowell, Mass.; J. H. McLeary, R. W. Stayton.

Chicago, Ill.—Watson Telephone and Telegraph Co. Capital, $1,000,000; to operate a telephone and telegraph system. Incorporators, Vernon Cassard, Evan Humphrey add Herbert S. Schwartz.

Snow Hill, Md. A company has been formed here for the projection of a telephone line connecting Berlin, Snow Hill and Pocomoke City. The company is composed of George S. Payne, J. Edward E. White, Irving T. Matthews, John P. Moore, and Dr. W. D. Straughn. The company will apply to the city council at once for a franchise.

Macon, Ga.—Simon Baer, of Atlanta, and others, will organize the Macon Telephone Co. Capital stock, $100,000.

Milledgeville, Ga.—The Milledgeville Telephone Exchange has been organized by C. W. Richter and others. Capital stock, $4,000.

Snow Hill, Md.—Geo. S. Payne and others have incorporated the Snow Hill Telephone Co., to construct a telephone line.

Alexandria, Va.—The United States Telephone and Telegraph Co. has been incorporated; F. B. Hubbell, president; W. J. Atkinson, general manager. Capital stock, $1,000.

Norfolk, Va.—An underground metallic circuit telephone service will be established by the recently incorporated Southern States Telephone Co., of Baltimore, Md Over 700 subscribers have been secured. C. E. Fink, of Westminster, Md., president; T. C. Thomas and J. D. Mason, Baltimore, and others, directors. Capital stock, $200,000.

ELECTRICAL and STREET RAILWAY PATENTS.

Issued May 19, 1896.

560,184. Magnetic Separator. Frank J. Barnard, Seattle, Wash., assignor of two-thirds to John Charles Moore and John Detwiler Atkinson, same place. Filed Sept. 10, 1895.

560,193. Block-Signal System. Alvah L. Creelman, Chicago, Ill. Filed Dec. 21, 1894.

560,195. Sales-Indicator and Alarm. Carroll F. Davis, Missoula, Mont. Filed Aug. 2, 1895.

560,216. Electromagnetic Dash-Pot. John D. Ihlder, Yonkers, N. Y., assignor to the Otis Brothers & Company, New York, N. Y. Filed Feb 8, 1895.

560,217. Electric Automatic Stop for Elevators. John D. Ihlder, Yonkers, N. Y., assignor to the Otis Brothers & Company, New York, N. Y. Filed July 27, 1895.

560,255. Hanger for Electric-Arc Lamps. Thomas H. Brady, New Britain, Conn. Filed Jan. 4, 1896.

560,262. Head-Block for Arc-Lamps. Alfred N. Edeburn, Cleveland, Ohio. Filed Aug. 12, 1895. Renewed Apr 15, 1896.

560,265. Electric-Railway System. John C. Henry, Westfield, N. J. Filed Nov. 26, 1895.

560,269. Electric Railway. Nicolaus Leidgen, Milwaukee, Wis. Filed Mar. 11, 1895.

560,270. Street-Car Fender. Joseph H. Leightner, Cincinnati, Ohio, assignor of one-half to John C. Otis, same place. Filed Nov. 8, 1895.

560,272. Connection for Storage Batteries. Robert McA. Lloyd, New York, N. Y. Filed Nov. 16, 1895.

560,284. Electric Igniter for Gas-Lighting. William F. Rudolph, Philadelphia, Pa., assignor to William E. Barrows, same place. Filed Sept. 6, 1895.

560,291. Electrical Furnace. Edward G. Acheson, Monongahela City, Pa. Filed June 25, 1894.

560,293. Train-Signal. William Biddle, Brooklyn, N. Y. Filed Mar. 22, 1894.

560,313. Polar Relay. Thomas B. Dixon, Henderson, Ky. Filed Mar. 27, 1896.

560,315. Electrically-Actuated Dental Plugger. John W. Gilbert, Philadelphia, Pa., assignor to the S. S. White Dental Manufacturing Company, same place. Filed Nov. 7, 1895.

560,317. Car-Fender. Anthony Iske and Albert Iske, Lancaster, Pa. Filed May 1, 1895.

560,318. Car-Fender. Solomon A. Kneedler, Philadelphia, Pa., assignor of one-fourth to R. B. Getman, same place. Filed Aug. 7, 1895.

560,328. Dynamo-Electric Machine. Richard Schorch, Darmstadt, Germany. Filed Dec. 14, 1893. Patented in Switzerland, July 27, 1892, No. 5,445.

560,340. Shunt-Circuit Water-Rheostat. Jules Buchel, New Orleans, La. Filed Dec. 7, 1894.

560,358. Electrical Annunciator. George J. King, Oakland, Cal. Filed Nov. 21, 1895.

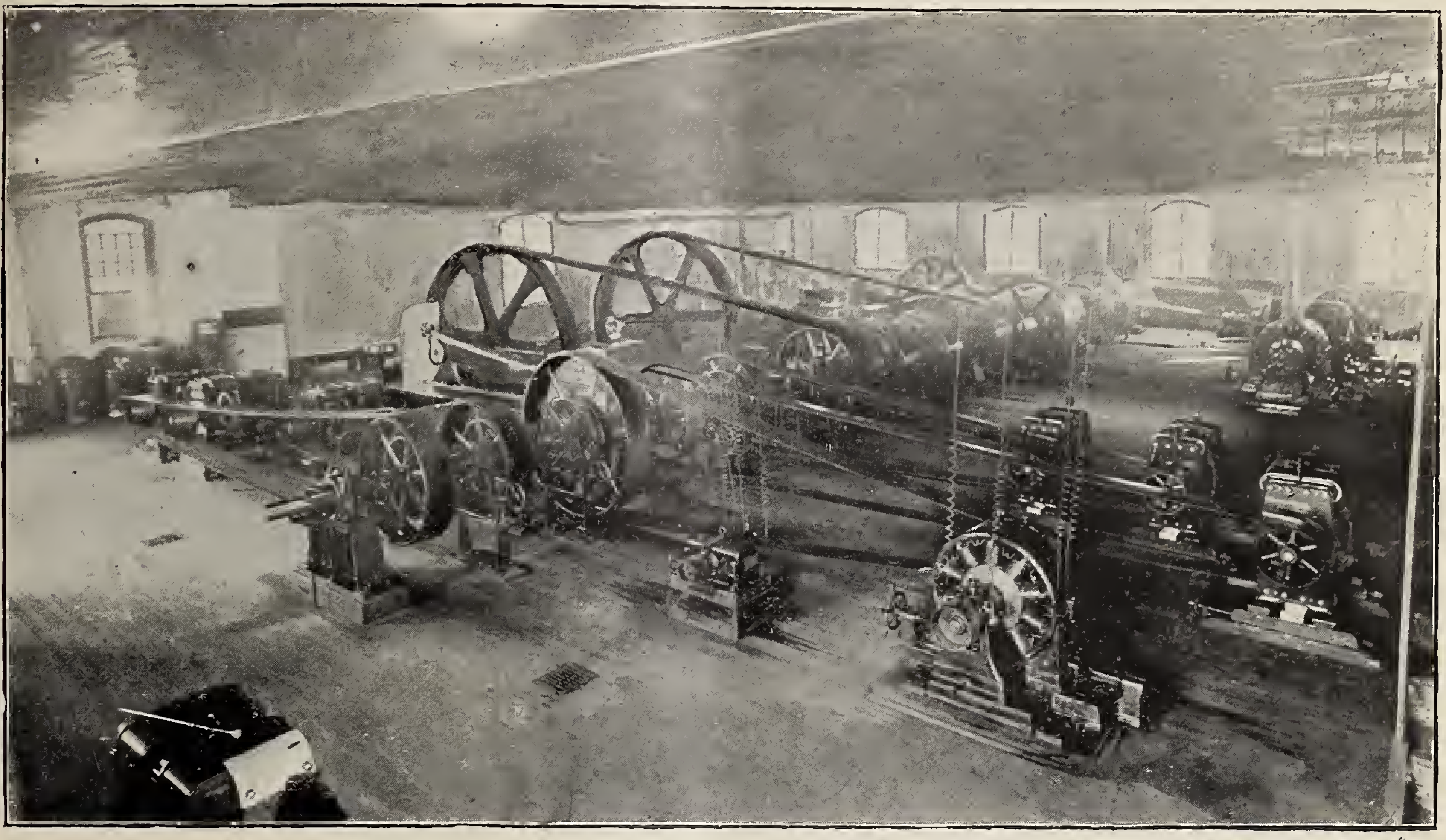
560,359. Device for Railway Signaling or other Purposes. Michael B. Leonard, Richmond, Va. Filed Feb. 5, 1895.

560,360. Electrical Apparatus and System. Michael B. Leonard, Richmond, Va. Filed Feb. 19, 1895.

560,361. Spark-Arrester. Miles E. Loehr, Claypool, Ind. Filed July 22, 1895.

The Electrical Age.

Vol. XVII., No. 25. NEW YORK, JUNE 20, 1896. Whole No. 475



TRANSMISSION PLANT.

POWER TRANSMISSION.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

The transmission of power has always been a subject of interest and importance to the engineering world. Many methods wasteful in the extreme have been applied for this purpose, and with few exceptions over any but a limited distance have failed. The transmission of power is a problem in any case dependent upon local conditions, the nature of the power developed and certain special circumstances which affect the power received.

Means of transmission.—Many purely mechanical methods have been attempted for the transmission of power, some of which are in practical use today.

Transmission of power by Steam.
" " Wire Rope.
" " Shafting.
" " Compressed Air.
" " Water.
" " Electricity.

Steam.—The amount of power that can be economically transferred by steam, shafting or water is limited.

Condensation is very heavy in steam pipes reaching over a long distance. The New York Steam Company, in this city, furnish an example of the transmission or, let us better say, the distribution of power by means of steam. It would be well to draw some line of distinction between the transmission and the distribution of power. When energy, in whatever form it may be, is transferred from point to point by an appropriate system of devices its distribution does not occur until it has been delivered. We therefore term a single artery of power the line of transmission, and the ganglion at its further end the point at which distribution takes place.

Shafting.—It is not difficult to imagine the vast quantity of power lost by a system of shafting and belting. The friction of the moving parts and lack of perfect elasticity in the belts are sufficient to cause a heavy consumption of power.

Ordinary shops lose more than 40 per cent. of their power and long lines of shafting much more.

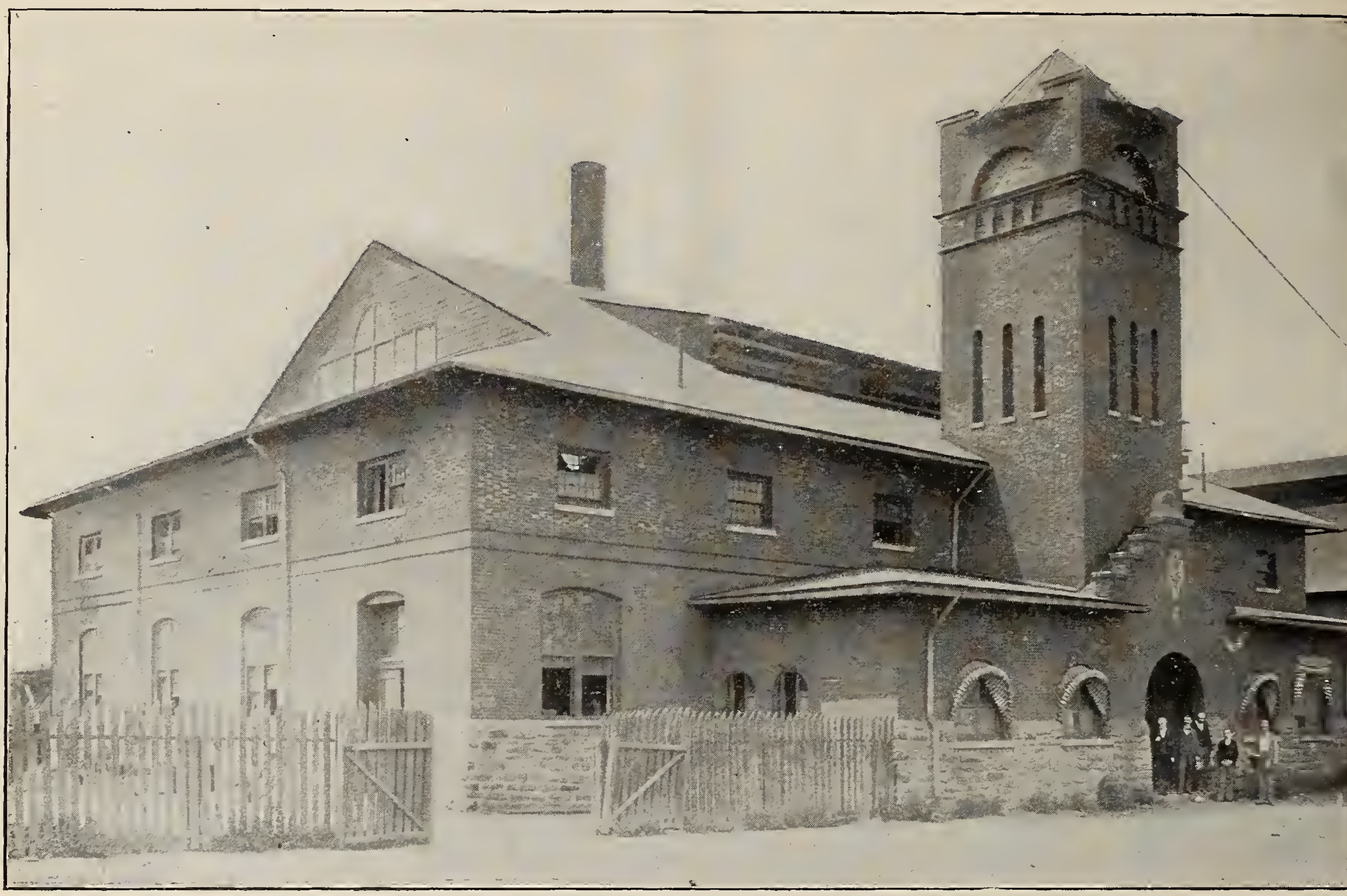
Water.—Water under pressure as a means of transmitting power has been tried in Paris with slight success. The large amount of water required for the production of little power is only too evident.

In this city the use of water motors on the faucets is expressly forbidden. About the only three that have met with much attention are wire rope, compressed air and electricity.

Compressed Air.—About 27 per cent. of the power has been recovered from a four-mile line in the case of a compressed air plant. The system consists in the compression of air at one end of a long pipe and its distribution at the other like water or gas to the consumers.

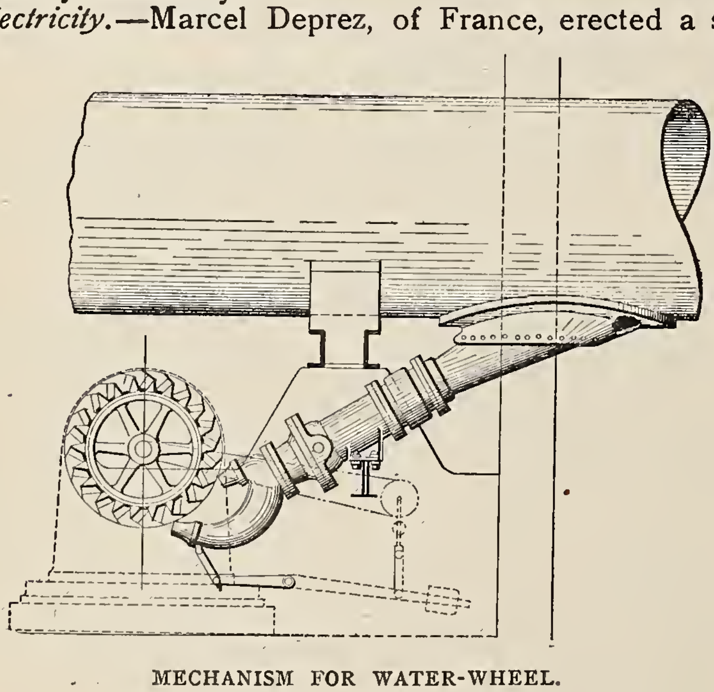
We see in all cases where power is transmitted by a fluid under pressure the necessity for a perfect pipe system and a very high pressure to meet with fair success. These two essentials are practically obtainable over short distances, but are difficult over very long lines without constant inspection and a heavy outlay of capital.

Wire Rope.—Many short wire rope systems that are entitled in one sense to the name of transmission plants exist in the form of cable roads. They are in long lines highly inefficient. As much as 80 per cent. may be lost in the plant from point to point. The friction is exceedingly high and the stiffness of the cable with its many turns and numberless pulleys make it but a poor means of transmitting power over long distances. We are thus forced to consider the advantages of the transmission of power by electricity.



POWER STATION.

Electricity.—Marcel Deprez, of France, erected a short transmission plant and recovered over a distance of several miles more than 60 per cent. of his power. Since then there have been many developments that depended for their outgrowth upon the improvement of both dynamo and motor.



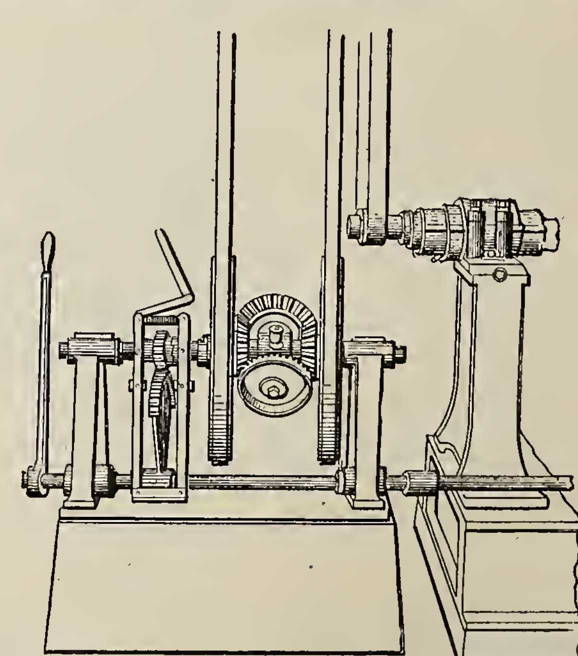
MECHANISM FOR WATER-WHEEL.

It is not difficult to conceive of a transmission plant in detail, for it is composed of three distinct elements :

Power house,
Line,
Receiving station.

Power House.—Power is not as a rule transmitted unless the fuel is exceedingly cheap in comparison with the town receiving the power, or it is obtained from natural resources such as water-falls. A power house might be constructed near a coal mine and the refuse coal or culm, which hardly pays the cost of transportation, consumed and its power transmitted miles away.

A water-fall such as Niagara is may be harnessed and



GOVERNING DEVICE.

its potent force distributed to a score of towns. But lately the Western Union lines were used for the transmission of power from Niagara to New York. Under the head of power house it is but proper to consider the systems that are under consideration for the transmission of power. They are :

Direct current,
Alternating current.

Of the two the alternating is most frequently used. It is not applied in its simple alternating form, but as a current of two, three or more impulses, it being then called a two-phase or three-phase current, etc. The advantage of this lies in its ready application to motors, which otherwise would not be easily run without extra devices.

High pressure.—To facilitate the transmission of energy without the expense for heavy conductors that would otherwise ensue, a high pressure is generally employed.

Whether the power be transmitted by alternating or direct current the potential of the line is over 2,000 volts, even at times as high as 10,000 volts.

The saving in copper is very noticeable with changes of pressure.

The law governing the size of wire is expressed by the following words : "Make the wire of such a size that the interest on the first cost is equal to the cost of power wasted in the line."

If the wire cost $1,000.00, the interest at 6 per cent. is $60.00; the wasted power should not cost more than $60.00 a year to satisfy the limitations.

Both line and distributing systems are included under other headings; but the general system in both direct and alternating that is used might be called—

(1) *Step-up system,* or the *generation* of low pressure and its transformation into high pressure to send over the line.

(2) *Step-down system.*—The reception of this high pressure at the end of the line and its retransformation down to a pressure fit for distribution in the city.

A NEW METHOD OF STUDYING THE LIGHT OF ALTERNATING ARC LAMPS.

A paper presented at the 104th Meeting of the American Institute of Electrical Engineers, New York, March 25, 1896.

BY WILLIAM L. PUFFER.

(*Continued from page 322.*)

The method chosen was the stroboscopic, which has given us at the Institute of Technology most excellent results in the hands of various experimenters while investigating the movement of transmitter electrodes, telephone diaphragms, tuning forks, vibrating strings, and the like.

A hand regulating arc lamp was placed in a lantern, with a large achromatic lens so adjusted as to make an image of the arc some ten feet long on the screen of the lecture room. A transfer switch and suitable rheostats were arranged so that either a direct current or an alternating current of about fifteen amperes could be used. At a convenient point a disk of about eighteen inches in diameter, in which were cut eight narrow radial slots, was placed so that the beam of light was interrupted as the disk revolved. The disk was fixed to the shaft of a direct current motor whose speed could be adjusted very closely by a rheostat in the armature circuit.

As the alternator used was a 125-cycle dynamo, and the disk had eight slots, the stroboscopic effect would be produced when the light of the arc would be allowed to pass at a frequency very slightly more or less than that of the dynamo, or

$$\frac{125 \times 60}{8} = 937\tfrac{1}{2}$$ revolutions per minute of the motor armature.

Suppose, for example, it ran at 937 revolutions per minute, then, counting from the time when the current in the arc was zero, each receding flash of light would be $\frac{1}{250}$ part of a complete alternation behind the preceding one, an owing to the persistency of vision the arc would be seen on the screen, as if the alternations had been so reduced in speed that it took two seconds for a single alternation of the current.

An attentive watching of the image as the current alternates is now highly interesting and instructive, and can only be seen to be fully appreciated.

It is clearly shown that the alternating current arc is a sequence of direct current arcs, alternating in polarity, and that each wave of current produces very clearly and distinctly all the attributes of the direct current arc.

The hot positive carbon with its white hot crater, from which extends the fan-shaped blue light of the arc to the small white tip of the colder negative carbon, will be seen to die away, and all light goes out except the glow of the red hot carbons, and then light appears again with the current reversed.

Early in November last the subject was again taken up, with the very efficient aid of Mr. R. R. Lawrence, a post-graduate student in electrical engineering at the Massachusetts Institute of Technology, and rapidly developed with such beautiful results that it was decided to exhibit publicly before the Society of Arts, which was done some little while after, at the regular meeting of January 2, 1896.

We first attempted to take a set of instantaneous photographs of the arc at different periods of an alternation, and by the use of a pneumatic shutter, and a progressive motion of the lens, obtained some very sharply defined pictures. After many trials this was given up, because of the practical impossibility of timing the exposures with respect to the alternations, and we decided to use a disk with half as many slots as there were pole-pieces on the dynamo, and to drive it by the shaft of the machine itself.

The dynamo available was one giving a three-phase 500-volt current with a frequency of about 60 cycles. Two wires only were used to give us the current required.

A somewhat long, light shaft, carrying at one end the disk, and at the other a positive mechanical clutch, was mounted in line with the armature shaft. As the clutch could only be thrown in when the two shafts were nearly equal in speed, a small motor was placed so as to bring the disk up to speed when the clutch was thrown in and the motor belt removed.

It will be seen at 0 degree, for example, there is no current on carbon 1 and that 2 is negative and 3 positive, the blue fan-like arc curving from 3 to 2; 30 degrees later, 2 is still negative and 3 positive, but that an equal arc is now playing from 1 to 2. At 60 degrees 2 is still negative, 1 positive, but there is no current at 3. At 90 degrees the appearance is somewhat like 30 degrees, except that the signs are changed and the point with the double current is necessarily much whiter, it being now positive. And so on through the changes of the complete wave.

This three-phase arc, when seen while the disk is running non-synchronously, is the most beautiful of any studied, and may be seen according to the different length of arc and the divergence of the disk from exact synchronism, either as a band of blue light which seems to be progressively travelling over the three sides of a triangular path, or as a rapidly spinning star of blue light, being in fact a rotary arc.

The three-phase arc is less noisy than the single phase, and its light is steadier and has less variation in its total intensity, owing to the fact that the current never stops, and there is always a positive carbon. Three-cored carbons, placed parallel side by side, with slight magnetizing coils to keep the arc at the ends of the carbon, will give a very satisfactory light in the direction away from the tips, and may be used when it is desirable to throw the light all in one direction.

Four carbons at 90 degrees apart, each with a suitable resistance in series with it, and connected to quarter-phase tap wires on a Gramme ring or other generator giving quarter-phase circuits, will also produce a rotary field arc of great beauty and interest.

Study of these arcs is still going on at the Institute of Technology under my immediate charge, which will, I hope, produce results sufficiently interesting to justify a second paper at some later date.

Welch, W. Va.—The Flat-Top Central Electric Power Supply and Traction Co. will be organized by I. T. Mann, L. E. Tierney and others. Capital stock placed at $500,000.

EXHIBIT OF THE ROOT IMPROVED STEAM BOILER AT THE NATIONAL ELECTRICAL EXHIBITION.

Our illustratiion gives a very good view of the exhibit made by Messrs. Abendroth & Root Mfg. Co., 28 Cliff street, New York, of their famous improved Root water-tube steam boiler, at the recent National Electrical Exposition, New York City.

These boilers were selected by a special committee to furnish all the steam used at the exposition, the desire being to install a thoroughly reliable and model up-to-date boiler plant.

This was the only working boiler plant shown, and attracted an immense amount of attention and favorable comment from visitors who could not but be impressed with its cleanliness, efficiency and the ease with which it was managed. There were two equal units forming one battery of 500 horse-power. A Wilkinson automatic stoker was used to distribute the coal upon the fire. The evaporative efficiency ranged from 10 to 11 pounds of water to a pound of coal. The C. W. Hunt Noiseless Conveyor was used in delivering the coal and removing the ashes.

So safe and simple was the entire operation of this plant that it was put in charge of Mrs. Frank Walton, a licensed woman engineer, who, as chief engineer, managed the exhibit with rare skill and judgment.

The battery of improved Root boilers used at the National Electrical Exposition was an exact duplicate of the six batteries of Root boilers used at the celebrated tunnel plant of the Baltimore & Ohio Railroad in Baltimore, Md.

South Africa is a promising colonial district. It is receiving impressions from the outside world in a very rapid manner. The Abendroth & Root Mfg. Co. sent three of their improved Root boilers to Johannesburg, South Africa, last May, to fill an order coming all those thousands of miles. This is quite a tribute to its excellence and far-reaching fame. That is about one of the best tests of a good article. To see whether people think so well of it, they will send thousands of miles to get it. If the boiler is examined, many reasons will occur to you explanatory of *this* order and of many others not mentioned. Straight tubes, easy inspection, no bending, cracking or straining due to an expansion that is not allowed for. A readily repaired boiler that is large enough and well made enough to be a pleasure to the engineer. These are things that can be reviewed *without undue expansion of the truth.* Everybody that uses the boilers says the same thing and we are only repeating it.

ROOT IMPROVED BOILERS AT THE NATIONAL ELECTRICAL EXPOSITION.

Would the South African gold mine people send in their fourth order in eight months if they did not experience the highest satisfaction from its use? Why, boilers that were just bought have been replaced by the Root. It heats water very quickly and without risk of life or limb to the fireman. If you think of building a new plant or of changing your boiler for another, congratulate yourself that you have seen this article. You will be very sorry if you don't follow such good advice as is given. Send for catalogue to Abendroth & Root Mfg. Co., 28 Cliff street, New York City.

The steam pipes in view are covered with the magnesia sectional covering made by R. Keasbey, 54 Warren street, New York.

THE EVOLUTION OF THE ARC LAMP.

L. H. ROGERS.

(*Continued from page* 313.)

I quote from a recent article by Alex. Dow, of Detroit, "In the plant I operate, analysis of the "outs" for two months showed that lapping was responsible for too much of the total trouble. We were running with $\frac{7}{16}''$ carbons in both holders. We changed to $\frac{5}{8}''$ uppers, retaining the $\frac{7}{16}''$ lowers. Result for four winter months operation of 1,480 street arcs, is just one "out" by lapping. Mr. Dow is ahead of the lamp he tried to fix. He neglected to state that he was compelled to break his $\frac{5}{8}'$ carbons off so that the weight would be no more than a $\frac{7}{16}$x12. This lamp was not designed on evolved ideas. A heavier weight in the upper carbon-holder would position the armature in a different plane as regards operating magnet.

The double carbon lamp has outlived its usefulness. It filled a gap for a few years. Its only recommendation is that it will burn all night long. Its drawbacks are numerous. More mechanism is required. Two carbon rods with two sliding contacts. The arc is struck well up near the top of the globe at one side—not in the centre—and travels downwards. This causes an uneven heating of the glass, which results in globe breakage, especially in severe climates. I have known a number of superintendents who always took the precaution to crack their globes with a soldering iron before putting on; then, by putting on a net, the unequal expansion and contraction was overcome.

Never losing sight of the fact that the function of an arc lamp is to *diffuse light—as much light as possible*, and *in every direction possible*—any unnecessary opaque substance which is interposed between the arc and the surrounding space to be illuminated shows a defect which is simply monstrous. With one pair of carbons burning 16 hours, we need have only one single arm of small cross section reaching down to sustain the globe holder. The shadow from this arm can be thrown directly against the pole or building, leaving absolutely unobstructed light for the street. We can arrange the trimming to be done quickly and without touching the globe. The globe can be cleaned without removing.

It is a very noticeable fact that those who have had the most intimate acquaintance with arc lamps and have operated practically the largest lighting stations for the longest time are the men who are the most eager to hear of a lamp constructed on new principles.

The West Side Park, Chicago, is about purchasing a large arc lighting plant—one of the largest ever installed at one time. They want 750 arc lamps. The specifications drawn by their engineer, Mr. Force Bain, reached me a few days since. They are sufficiently unique to be preserved. His idea, I think, is new. He asks a number of questions. The bidder is to answer these questions on blanks furnished, said answers to form the guarantees of the bidders.

These specifications read as follows:

Single or double carbon?

Size of carbons? Upper.... Lower....

Cross section?

Market price of such carbons per 1,000?

Length of time the lamp will burn with one trimming, in circuit of 9.6 to 10 amperes and a difference of potential of 45 to 50 volts at terminals of lamps?

With 6½ amperes and 45 volts?

Will the lamp burn at a practically constant voltage of 45 to 50 volts while the current may be changed from 9.6 amperes to 6½ amperes?

If not, what range do you guarantee?

In stating guarantees above, do you refer to the use of plain or plated carbons?

State make of carbons referred to.

If such carbons are covered by patents, making them a monopoly, state price per 1,000 you hereby guarantee they will not exceed for a period of five years from date hereof?

By what means are the carbons adjusted to a coaxial position?

By what means are they maintained in a position coaxial with regard to each other?

What is the extreme length of lamp?

What is the weight of lamp with globe, trimmed and hung ready for operation, with hood and hanger board, if such be necessary?

How many side rods for supporting the globes and negative carbons?

Diameter of each intercepting the rays from the arc?

Length?

Is it necessry to remove or disturb the globe when trimming the lamp?

Does your lamp require a special globe?

If so, at what price do you guarantee they will not exceed for a term of five years from date?

Of what material is the jacket or case composed?

How removed for inspecting the operating mechanism?

Is the lamp shunt or differential?

After the arc is struck, is the series coil retained in circuit?

Is its responsive mechanism in continuous active motion?

What is the electrical resistance of the series coil and its connections?

What is the resistance of the shunt coil?

Of what size wire is it composed in decimals of an inch?

How many active pivotal joints in operative mechanism?

How many springs in the lamp?

How many variable adjusting devices are there in the lamp?

Are they sliding or pressure?

Of what metal composed?

Maximum current carried?

Can they be readily replaced?

Will the automatic cut-out re-establish the arc when the carbons together?

Within the limit of what number of volts can the cut-out be adjusted to positively operate?

If a double lamp, what is the difference of voltage between two pairs of carbons when in normal operation?

Is any resistance cut into the main circuit when the lamp automatically cuts out?

How many ohms?

What is the form of cross section of the carbon feeding rod?

How is the circuit completed through the rod?

What is the area of surface contact of the clutch with the rod in decimal of square inch?

What is the voltage and current at which the lamp is best adapted to operate?

State the maximum and minimum voltage between which the lamp will operate and feed in practical service, during a period of six months?

Mention any special features of your lamp.

The man who could as those questions is hunting for an arc lamp different from the ordinary. They show that he has fought and bled with a multiplicity of spools, springs, rods, sliding contacts, lapping carbons, broken globes, and rusty sheet-iron cases, and that he has lived within the dark shadows thrown by the old style lamps, and gazed for years upon landscapes marred by the contours of the arc lamps of the period of 1875 to 1895.

WORCESTER POLYTECHNIC INSTITUTE.

By recent enactment of the State Legislature twenty new free scholarships in the Worcester Polytechnic Institute become available to the next entering class. This makes forty free scholarships in all available, being one for every senatorial district in the state, in addition to the twenty-five or thirty free scholarships to which students from Worcester County only are eligible.

RESULTS ACCOMPLISHED IN DISTRIBUTION OF LIGHT AND POWER BY ALTERNATING CURRENTS.

W. L. R. EMMET.

The introduction of successful polyphase motors has constituted a very radical and important step in the development of the electrical art. The number of persons who realize the importance of this step is as yet small, and, like other new things, it cannot attain great successes until its merits and possibilities become more or less familiar to the public and to the practical business men on whom the responsibilites for new developments must largely rest.

In the past, the use of alternating currents has been almost exclusively for incandescent lighting, and this narrow limitation has crippled the development of the art. While the applications of direct currents have called forth very large investments in plants and distributing systems, the uses of the alternating current have, as a rule, been on a much smaller scale, and the methods used have been developed rather with a view to reduction in first cost than to the attainment of the most economical results in operation.

The reasons for this somewhat half-hearted development may be stated as follows :

First—The average efficiencies attained in most alternating plants have been very low.

Second—The distribution of potential obtainable with the ordinary methods has been imperfect.

Third—No reliable alternating arc lamps have been available.

Fourth—No practicable form of single-phase alternating current motor has, up to the present time, been introduced.

At no time have all these diffieulties been entirely unavoidable in alternating current distribution ; they have, however, been fixed features of the system as it has in the past been installed by our manufacturing companies and used by electric light companies in this country ; the state of the art being such that improvements were beyond the reach of most central station managers.

In recent years great developments have been in progress in the branches of electrical science pertaining to alternating currents ; much new apparatus has been developed, plants have been installed on new lines, and practical results are today being accomplished that show that it is possible to overcome all of the objections which have been mentioned.

We will briefly review in order some of the means by which the difficulties mentioned have been and can be avoided.

EFFICIENCY.

The greatest losses in the average alternating plant are due to the waste in iron cores of transformers, which goes on whether the transformers are loaded or not. This waste can be reduced, either by the use of transformers of high light-load efficiency or by arrangements for cutting out transformers at light load.

Where primary distribution is used with large numbers of independent transformers, the extent to which these remedies can be adopted is very limited, since reduction of core loss can be obtained only at the expense either of regulation or of first cost.

If, however, secondary distribution is used, that is, low-tension mains with transformer sub-stations, it is often possible to arrange means of cutting out transformers at times of light loads.

Furthermore, on such systems very accurate regulation in transformers is a matter of no importance, since all transformers divide the load more or less evenly between them, instead of operating from the same line at various conditions of load as in primary distribution. Thus, for this secondary work, we can build special transformers having very small core losses and thus obtain very high all-day efficiency without impairment of regulation.

I have in mind a large plant now being equipped with alternating apparatus for lighting and power distribution on thoroughly modern and improved lines. In this case a system of three-wire, low-tension mains is to be laid over a large area These mains will be at street corners from specially designed transformers in ventilated manholes. These transformers are to be of 100 kilowatts each, and are to have a core loss of only 500 watts, or one-half of one per cent. of the capacity. The efficiency of these transformers at one-quarter load will be higher than at full load, the principal loss being in the copper. Thus a transformer may be made to fill the same functions as a direct-current feeder. If we are willing to introduce some drop between generator and main, we can get high light-load efficiency with moderate cost, and we shall retain the important advantage that transmission is possible over long distances, with small losses, through the use of high voltage.

In no branch of electrical work has the improvement of recent years been more marked than in the manufacture of transformers. This improvement has not been brought about by any radical discovery as to the principles involved, but simply by study of the economic conditions. The quality of iron is a most important matter in building transformers, and the methods of handling and annealing are almost equally so. Then, the proportions by weight of iron and copper may be varied through a wide range, and the plan of arrangement of coils and iron are susceptible of endless variation.

(*To be Continued*).

A Cell of High and Constant E.M.F.—Yet another form of cell was recently the subject of a paper at the Paris Academy of Science, and, as usual, the special advantages claimed for it were high and constant E.M.F. The formation of the cell is stated to be as follows : A plate of retort carbon constitutes the positive pole, whilst the negative pole is a plate of amalgamated zinc. So far, there is nothing particularly novel, however; the positive pole is immersed in a (3 : 1 vol.) solution of potassium bichromate and sulphuric acid, the functions of which are obvious, whilst crystals of the former substance ensure by their presence the requisite strength. In this liquid there is also placed a porous pot containing a solution of caustic soda (sp. gr. 1.05,) and within this pot is placed a second porous pot, also filled with caustic soda, but of sp. gr. 1.25. This latter pot holds the negative pole. It is stated that the E.M.F. of this arrangement commences (after allowing an hour for it to get into good working order) at 2.5 volts, and remains above 2.4 volts for 10 hours; and that the internal resistance is 0.8 ohm. The increase of voltage in this cell over the common bichromate cells appears to be due to the substitution of the alkaline for the acid solution in which the zinc is commonly immersed ; but this is, we should think, accompanied by a rapid increase in resistance. The caustic soda will be converted into chromate, and hydroxide will soon coat the surface of the zinc, but the alkaline liquid will lessen the effect. The coating on the zinc may be removed by periodically dipping the plate in dilute acid, and this should be done after every 10 hours' run. For further details of this cell, and accounts of experiments made with it, consult the *Comptes Rendus*, cxxi., p. 251.

Elizabeth, N. J.—Bids are being secured by the Elizabeth Street Railway Company for the work of laying new tracks, etc., for the changing of the horse car line to trolley service. It will cost nearly $100,000 to change the system, and it is believed that the road will have to be bonded for more than half of that amount.

Landgrove, Vt.—Warren F. Leland, a native of Landgrove, took possession of the Windsor Hotel on Fifth avenue, May 1. $100,000 is to be spent in decorations and a new steam and electric light plant.

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CONTENTS.

ACCUMULATORS.

The value of storage batteries as an adjunct of station work is slowly being appreciated. At one time it was thought that the expense of their attendance and the rapidity with which they were supposed to deteriorate would dispel the idea of their use. Today such illusions have passed away. The storage battery has become a part of several station equipments of considerable size, and by a little expert care can be kept in perfect condition for a long period of time.

The storage cell has been bounced around for many years and applied to cases where success was only temporary. It was eventually discovered that in connection with station work it would, on a large enough scale, prove a profitable investment.

The work of a station can be greatly extended by their aid and heavy loads taken care of with readiness and ease.

The accumulators that are now sold for station work are in the form of special cells adapted to such work, and solid and substantial enough to cope with the variations of load experienced there without failure in any respect.

There is every evidence to show that their extensive use will soon be a matter of common observation. They have undoubtedly come this time to stay.

THE SITUATION.

It has been evident to many that the political situation directly affects business. Vast enterprises depend upon the issues of elections.

There are times when commercial disaster follows in the track of political aspirants, and leaves its mark like the blazing torch of war upon the homes of innocent men. When a country suffers, who are the sufferers? The vast class of artisans and workmen; those that have toiled to make their mite and keep their heads above water. When certain great issues are in abeyance, interests that depend upon their settlement cease to be productive and there is a lull that deprives the laborer of his hire.

The field of engineering is directly affected. The projection of many schemes ceases to be actively pursued. Their culmination recedes into the future; the expert aid, muscle and material that would have been required remains latent and inactive. There is much depending upon the closing of political issues. At times their final scenes are like the last acts in a great drama. A yoke that scars the flesh is borne by the greater mass, and in this condition of misery and helplessness they must remain until relief sluggishly approaches.

The working class are patient to excess. They cast their ballot at times for the hand that smites them, but in these later years they pay less and less for the mistakes of political aspirants. The deep, hoarse murmur of myriad throats drowns the puny cry of base politicians and raises the glistening, golden plank of reform and common sense.

WHAT IS REAL?

What is real? None have ever decided. Neither matter nor personality, space or time. The two real things have been called extension and thought by a great philosopher of old. But the real, the tangible, can best be known by comparison with the unreal and the intangible. Science knows of nothing that is nothing. In all its investigations it has always met with the real. What then do we define as real—the indestructible, or that which by a process of thought and experience is considered as indestructible?

There is every inclination on the part of broad-minded savants to reduce matter down to one fundamental basis and explain its diversities in character and properties by the different effects of force upon either. This is to be expected as the final conclusion of the scientific world, provided the chain of reason can be forged with strong and unyielding links. The reality of all things within our compass will then reduce down to two of evident tangibility—force and the universal ether.

Edwards & Co., of 144th street and Fourth avenue, have their line of fine electrical specialties on the market in connection with many improvements upon the old. Their annunciator outfits and burglar-alarm door opener and electric bell equipments are noted throughout the trade. Some of the most satisfactory devices are made by this company, such as self-winding clocks, electrically controlled and excellent metal switches of neat and simple construction. Their programme dial for automatically ringing a series of widely separated bells is of the greatest advantage to schools and factories, announcing the hour to all instantly. The finish and excellence of their goods have established a reputation for Edwards & Co. that nothing can change.

The Twenty-eighth National Saengerfest of Pittsburgh, Pa., was opened by current sent through a wire (a sample of which is in the office of this journal), June 8, eight P. M., by President Grover Cleveland, from the Executive Mansion, Washington, D. C.

The Miller Electric Construction Co. of Pittsburgh, Pa., furnished all the details of the electrical work and made all the arrangements for connections with the White House.

THE COMMERCIAL VALUE OF ACETYLENE GAS AS AN ILLUMINANT.

BY LOUIS A. FERGUSON.

(*Continued from page* 314.)

It would be much better and more economical for the central station manager to sell his electrical energy through the incandescent or arc lamp at the same price per kilowatt hour, than to use the energy for the production of carbide, since the cost per candle-power hour would be less when the electrical energy is converted into light directly through the incandescent and arc lamps than through calcium carbide and pure acetylene, assuming the cost of distribution and general expense to be the same in each case. Take, for example, carbide at $40. per ton, which means forty cents cost per 5,000 candle-power hours of acetylene gas in the holder or 125 candle-power hours for one cent. Compare with this electrical energy at the switchboard at two cents per kilowatt hour. For each kilowatt hour generated we obtain twenty 50-watt incandescent lamps, each giving 16 candle-power, making a total of 320 candle-power hours per kilowatt hour, or 160 candle-power hours for one cent, which is 28 per cent. more candle-power for the same expenditure of money by the use of the incandescent lamp as a converter of electrical energy into light as against the conversion by means of carbide of calcium and acetylene.

If we take the case of the arc lamp and add to the cost of the electrical energy 1.5 cents per kilowatt hour for carbons, trimming and lamp repairs, making the total cost 3.5 cents per kilowatt hour, we find it still more advantageous. Assuming a 500-watt arc lamp gives 1,000 candle-power, we have 2,000 candle-power hours per kilowatt hour or 575 candle-power hours for one cent, which is 4.6 times the illumination for the same money as compared with pure acetylene gas.

Taking the cost per kilowatt hour at the switchboard in the large central stations we obtain 320 candle-power hours for one cent, which is 156 per cent. more candle-power for the same expenditure of money by the use of the incandescent lamp directly as a converter of electrical energy into light as against the conversion by means of carbide of calcium and acetylene.

By means of the arc lamp on the basis of cost of one cent per kilowatt hour for electrical energy and 1.5 cents per kilowatt hour for carbons, trimming and lamp repairs, we obtain 800 candle-power for one cent or 6.4 times the illumination for the same money as compared with pure acetylene gas.

From these deductions and considerations, gentlemen, it may be concluded in the light of our present knowledge, and upon the basis of the estimated cost of production of the calcium carbide, that acetylene gas should not drive the incandescent and arc lamp from the lighting field; neither should it make such inroads on the electric lighting business as to materially affect the earnings of existing central station companies, for, after all, acetylene is a gas and burns with a naked flame, and the use of incandescent and arc lamps has steadily increased year by year, not because of their cheapness but because of their infinite superiority as illuminants over any gas flame yet developed.

Compressibility of Ether. — Ether is incompressible. Its density has been computed on the assumption that its ability to transmit energy is dependent upon the same physical conditions that enable matter to transmit it; but it is evident that the term is not to be understood to mean what we mean when we speak of the density of the earth or of the sun; for a body which is not capable of compression and is without molecular structure, can hardly be compared with one which is.

Spon & Chamberlain, 12 Cortlandt street, New York, have on exhibition a full line of electrical books. They carry an exellent line of popular, low price book

Interesting Facts in Science.

Iron Mountain of Mexico. — Within the corporate limits of the city of Durango, Mexico, is a mountain of solid iron ore. The mountain is one mile long, 388 yards wide, and 640 feet high, and represents a total of 1,246-984,244 cubic feet of ore. This would be enough, it is estimated, to supply all the foundries of Great Britain with ore for 330 years, and the value of the metal so obtained would be nearly ten billions of dollars.

Half Coal Half Diamond.—A peculiar piece of crystallized carbon closely resembling a black diamond, yet differing in certain important particulars, was recently submitted to the French Academy of Sciences by M. Moissan. This carbon was found in the province of Bahia, Brazil, and weighs over one pound. It is said to be partly crystalline, and partly amorphous in nature. The latter places under the microscope show a honey-combed surface, such as are constantly found in lava or slag, and give the impression that gases have escaped out of the mass while it was in a liquid condition. M. Moissan considers that this specimen is a link which has so far been unknown, between graphite and the diamond.—*London Invention.*

A Material for Staining Steel.—A writer in *English Mechanic* recommends the following direction for oxidizing and blacking the bright work of steel in lieu of paint, to stand heat and to wear well: Take three ounces of glacial acetic acid, mix it with its weight of water; to this add one-half ounce of powdered nut-galls and let it stand for a day or two, shaking it up occasionally. Then let settle; then pour off the clear and put a pint of boiling water to the residue. When cold and settled, pour off the clear and mix with the first. Now to this add a grain of nitrate of silver or sulphate of copper or nitrate of copper. Dissolve whichever you use in a little hot water before mixing with the other liquid. Silver is the best process. Clean all oil off and rust or scabs, paint, etc. Clean all up bright with pumice-stone powder. Don't use emery in any form, but the above, with a piece of wood. Then clean all off; dry with air-slaked lime. Now go over it with the liquid with some cotton wool. If you have saved your powdered galls, take a little of that upon your wool; you will find that a great acquisition in the first application. Let it stand until dry; then give it another coat. When dry, scratch-brush it, and give it another coat, etc. When you have got it to your liking, give it some linseed oil and camphor. All bright iron parts can be made like ebony polished, and with the gun-metal mounting you will have a picture in black and gold. Cylinder covers, etc., can be done the same; but you must wash with hot water before oiling it. It will stand any amount of heat, the hammer and friction in wiping; you have no blistering, and you will have some difficulty in eradicating it. Bicycles, repairs, handle-bars, etc., can be treated the same way to advantage, well washed with hot water; when dry give them a coat of good copal carriage varnish.

The Ether Non-Atomic.—For us the ether is practically illimitable; it has no boundaries. If it has no boundaries, light waves would be reflected from it in every direction and the whole canopy of the sky luminous all the time. Investigation as to the minuteness of some waves and the conditions for producing such waves has led to the conclusion that the ether is not granular; that is, it is non-atomic.

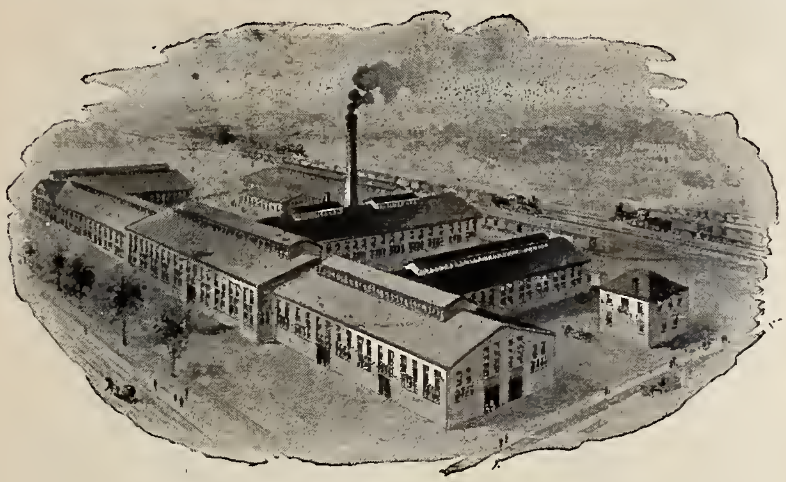
The Profundity of Space. — The light of the stars reaches us from space depths so profound that it requires thousands of years, travelling at the high rate of 186,000 miles a second, to reach the earth, and every increase in the aperture of the telescope shows the existence of others still more remote.

Ether Transmitting Energy.—Ether is capable of transmitting energy of certain forms with the velocity of light. Its ability to do this is attributed to its elasticity, although such elasticity as it has is wholly unlike the elasticity of any body of matter.

THE C. & C. ELECTRIC CO.

The demand for good machines has at length controlled the market.

The C. & C. Electric Co. have recognized this fact for many years; they were prepared to give people what they asked for years ago, and now that the time has come when only those dynamos and motors which reach the highest

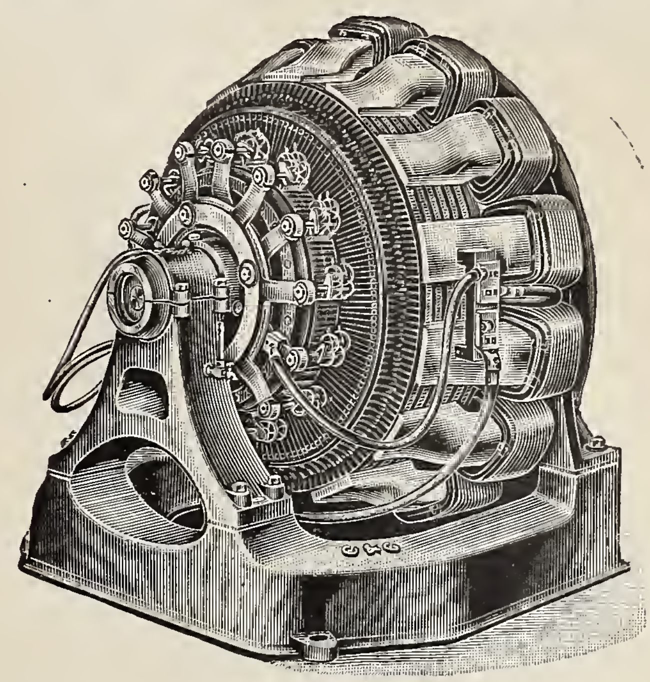


FACTORY OF C. & C. ELECTRIC CO.

standard of efficiency can sell, the C. & C. Company stands prepared to supply all comers, to satisfy the most critical and equip the very largest establishments.

They have not let the grass grow under their feet. Their goods show this at once. The most improved methods of construction are in vogue by them. The machines they sell will stand an overload without flinching.

drill presses, shapers and planers are all driven by motors and give by this means a flexibility and convenience, and above all an individuality, to each tool that far surpasses the old worn-out methods of ancient machine shop practice



NEW GENERATOR.

with its long belt, heavy shafting and oil-dripping appurtenances.

When a group of small tools are together one motor supplies power to them; otherwise, each is distinct with its own motor at command. Some of the sketches show the

PROXIMITY TO RAILROAD.

It is not difficult to understand why a good dynamo is bound to succeed. Is not the same true for all other articles? Does not its own inherent qualities speak most eloquently for it? We think so.

The C. & C. Electric Co. have studied the market very carefully; they obtained the best designers, secured the services of able mechanics and paid for the best material the country afforded. Let us see why the machines of the C. & C. Electric Co., are of superior construction and design.

Their factory at Garwood, N. J., is a model equipment.

The dangers from fire are at a minimum and the building for convenience and spaciousness could not be excelled. The New Jersey Central Road has a shunt leading into their yard; the goods when completed are at once carried away.

A Ball engine drives the machinery, running a 50-K. W. and a 100-K. W., generator.

A curious and deeply interesting feature of their distributing system lies in the fact that the power is on tap all over the shop at 220 volts, but is reduced down by a motor transformer to 110 volts. The system in use for the shop is the direct application of motors to all machines. Lathes,

methods of distributing the power to the larger and smaller machines.

The latest C. & C. multipolar is a model of neatness and ingenuity. It appeals to the technical eye as strongly as the budding rose with its perfume and color speaks to the artist. The magnetic circuit is practically perfect. A ring of steel with poles projecting at right angles composes the frame; all in one with the convenience of being able to slip a coil off with ease. A large armature revolving within these poles and wound with copper bars set into the armature gives us an ideal armature construction and an almost uninterrupted magnetic circuit. The most improved system of ventilation is carried on for the radiation of heat in the fields and armature.

The limiting capacity of any armature practically depends upon its power of radiating the C^2R losses. If this is carefully attended to the machines will stand a surprising overload.

The C. & C. generator varies in size from 25, 50 to 100 K. W.; they can stand a continued overload of over 25 per per cent., if necessary, without undue signs of failure in any respect. It is very important, in considering a dynamo, to keep in mind a factor which greatly determines its market

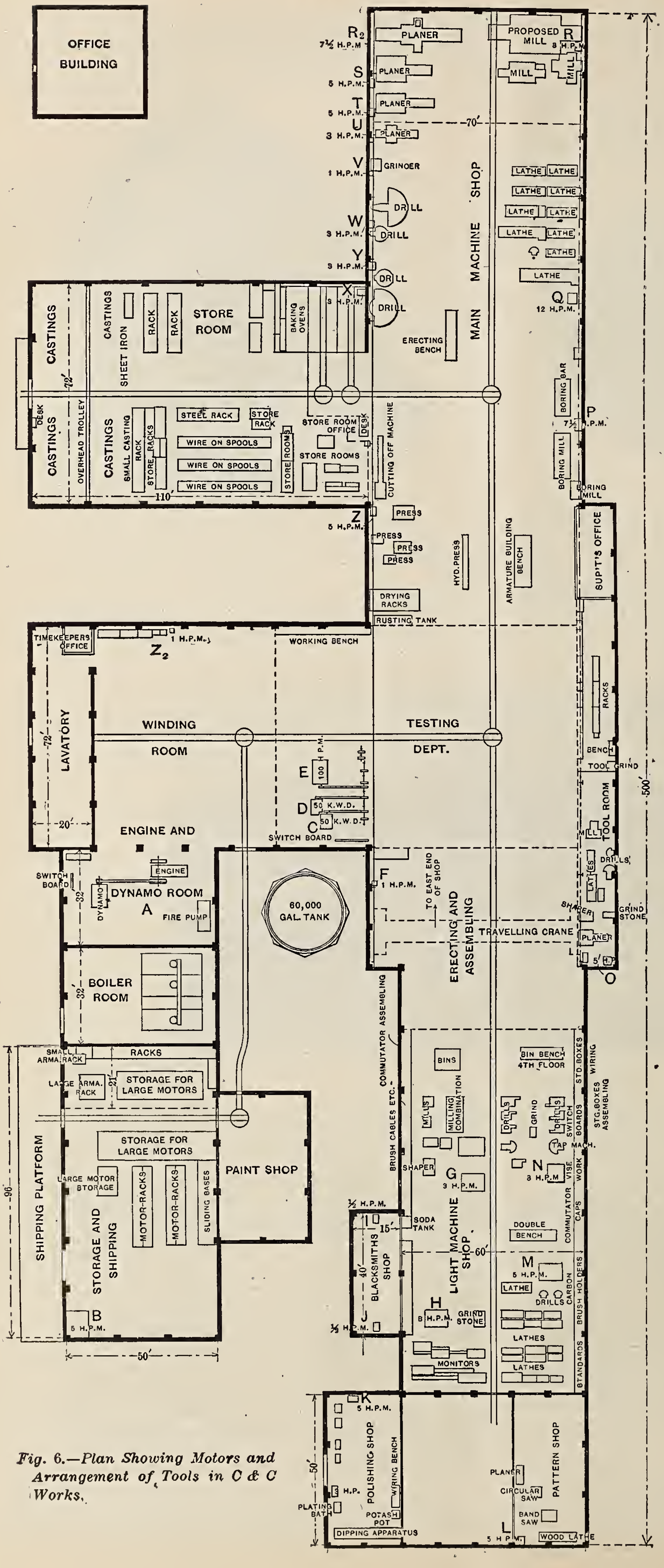


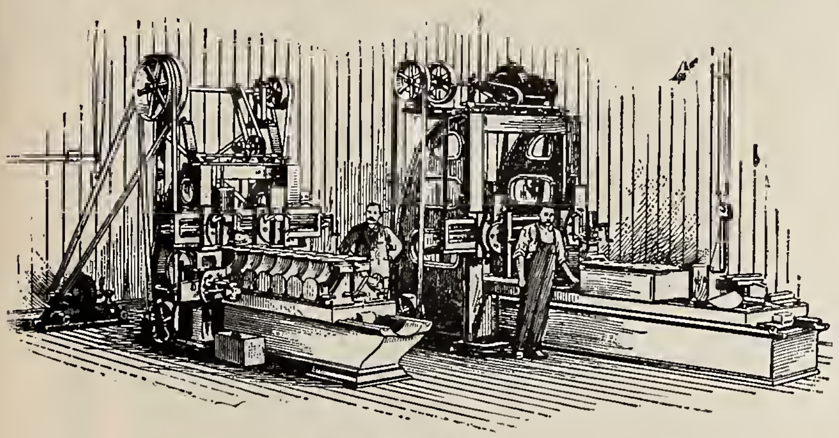
Fig. 6.—Plan Showing Motors and Arrangement of Tools in C & C Works.

INDEX OF MOTORS SHOWN IN FIG. 6.

A—80 K.W. dynamo running entire plant.
B—5 H.-P. hoist motor.
C—50 K.W. dynamo, 500 volts, testing plant.
D—50 K.W. dynamo, 125 volts, testing plant.
E—100 H.-P. motor driving testing plant.
F—1 H.-P. motor driving lathe.
G—3 H.-P. motor driving gang of mills.
H—3 H.-P. motor driving gang of monitors.
I—1½ H.-P. motor driving blacksmith bellows.
J—½ H.-P. motor driving blacksmith bellows.
K—5 H.-P. motor driving buff and emery wheels.
L—5 H.-P. motor driving pattern shop tools.
M—5 H.-P. motor driving gang of small lathes.
N—3 H.-P. motor driving gang of drills.
O—5 H.-P. motor driving tool makers' tools.
P—7½ H.-P. motor driving boring mills.
Q—12 H.-P. motor driving gang of lathes.
R—3 H.-P. motor driving milling machine.
S—5 H.-P. motor driving planer.
T—5 H.-P. motor driving planer.
U—3 H.-P. motor driving planer.
V—1 H.-P. motor driving emery grinder.
W—3 H.-P. motor driving radial drill.
X—3 H.-P. motor driving radial drill.
Y—3 H.-P. motor driving two drill presses.
Z—5 H.-P. motor driving gang of presses.
R^2—7½ H. P. motor direct connected to planer.
Z_2—1 H.-P. motor driving gang winding lathes.

value—the variation in E. M. F. with changes of load. This quality of self-regulation will mean success or disaster to any electrical concern. The C. & C. Electric Co. have fully realized the importance of providing a machine that would meet the needs of consumers and meet all changes of load with the least variation in pressure.

The multipolar generators do not require the movement

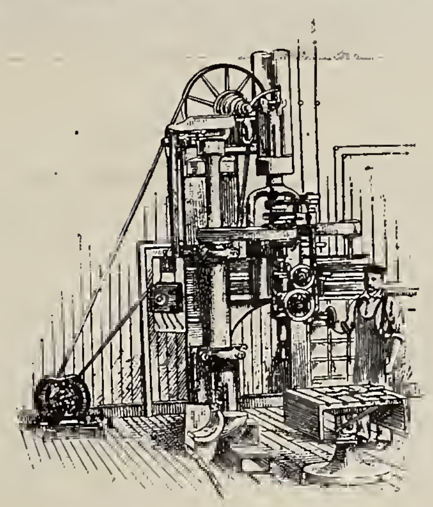


TWO PLANERS.

of a brush with an overload of 20 per cent., and their regulation is two per cent. on the average with all changes of load.

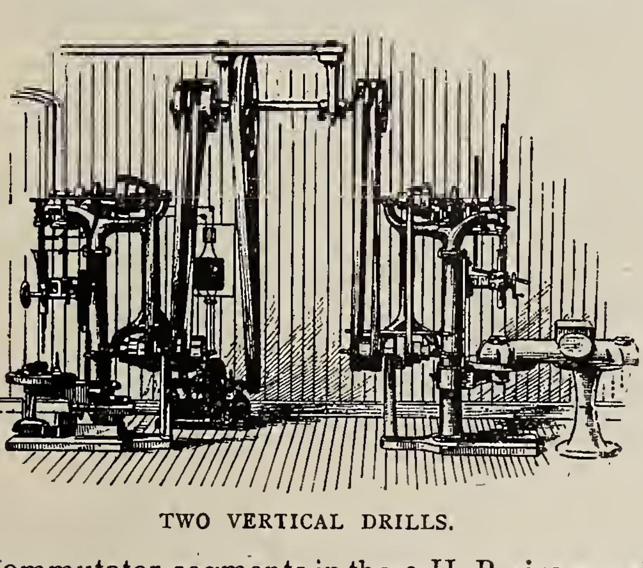
This means a great saving in lamps to the customer and the absence of any vituperation on the part of the engineer. The sketch shows the general appearance of this generator.

The bipolar machines that have been turned out by the C. & C. Company are almost by-words to the public. They



RADIAL DRILL.

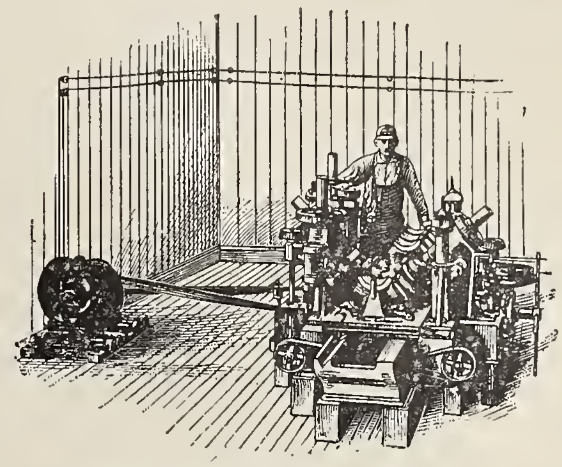
have brought a new type on the market of the Manchester pattern made of steel. It has many interesting points in its construction. The magnet flanges are of metal with raised projections to rapidly radiate all heat. The armature provides an air current as it rotates, thus keeping very cool, and being able to stand a very heavy overload for this reason.



TWO VERTICAL DRILLS.

The commutator segments in the 2-H. P. size are slightly staggered and the carbon brushes do not press abruptly, but on a slant like any copper brush, thus removing the chatter and shrill hiss usually met with. It combines some of the best features of dynamo design in its construction and will rise in the opinion of the trade and consumer upon inspection and use. Their testing room and its accessories, and their unequalled facilities for making machines to suit all circumstances and meet with all conditions, we attribute to their experience, skill, and honest enterprise.

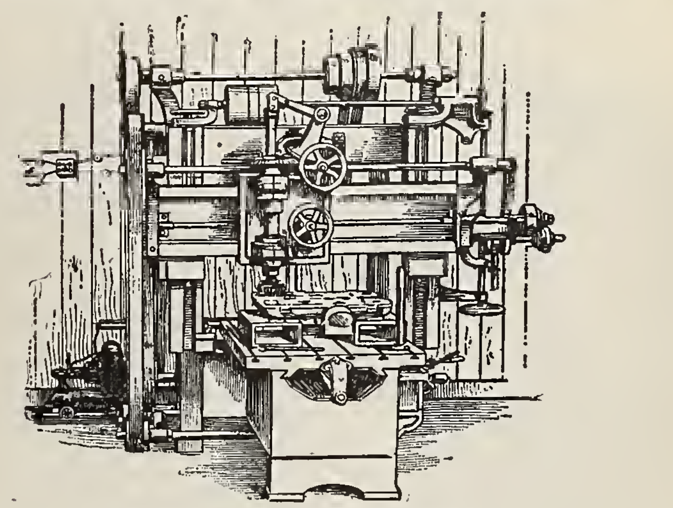
In offering the Type F motor starting-box to our friends and patrons, we feel sure that we shall be awarded credit for recording an advance in the right direction. This device, in addition to fulfilling the usual functions of a start-



SPECIAL MILLING MACHINE.

ing-box, is also possessed of a number of valuable features, and, in fact, is a complete controlling device for motors. An enumeration of its principal features are as follows :

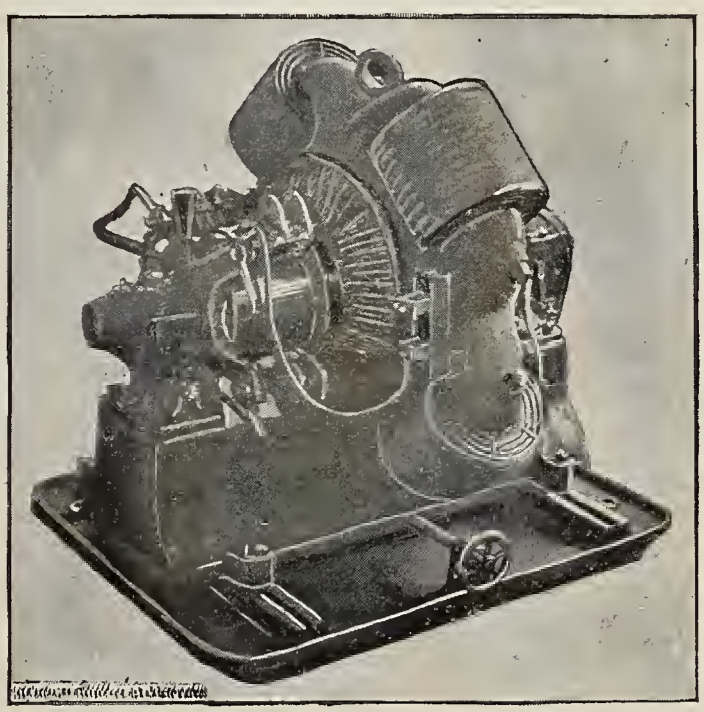
(*a.*) The motor may be started under full load and brought up to full speed, gradually and smoothly.



VERTICAL MILLING MACHINE.

(*b.*) The box is fitted with a double-pole and knife-edge switch for opening and closing the supply circuit.

(*c.*) The box is fitted with a double-pole fusible circuit-breaker for interrupting the service in the event the motor is overloaded or otherwise endangered, such as would be the result of a hot bearing.



TYPE 4 P MOTOR.

(*d.* The box is equipped with a *magnetic circuit-breaker* which will not only open the circuit for a service interruption, but also for an overload, which device is adjustable for an *automatic* section at any given load on the motor.

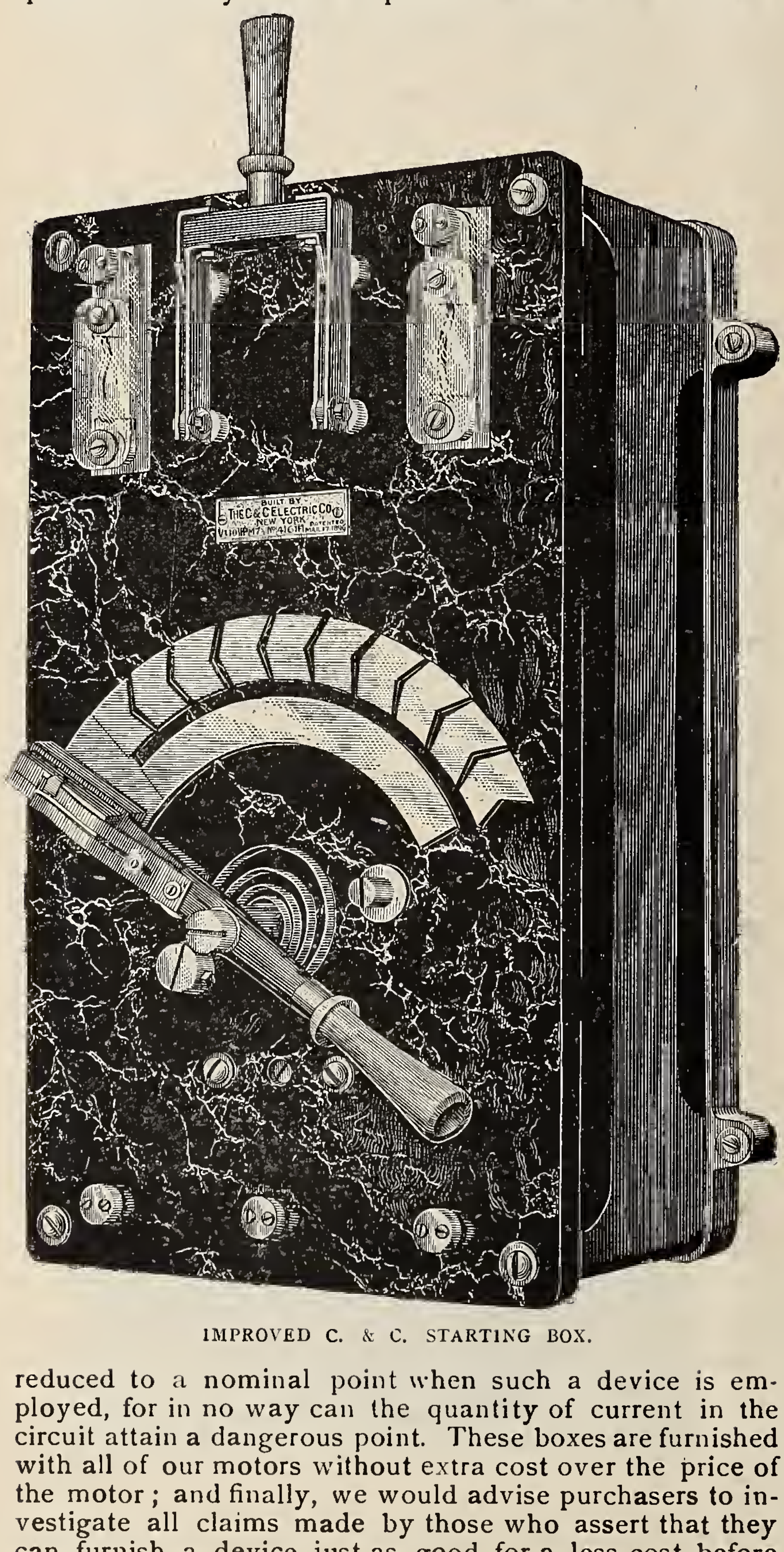
(*e.*) The contact lever is fitted with a spring motion which automatically throws the contact lever into the position of maximum resistance, either when the service is interrupted or when the motor is overloaded.

(*f.*) The sliding contact-piece is of carbon and copper combined, thereby guaranteeing ample carrying capacity, but also freedom from burned contacts and the other evil effects of the antiquated methods so much used.

(*g.*) The automatic circuit-breaker is provided with an auxiliary device which may be so adjusted that the device will act for opening the circuit and throwing the lever back in the event of the interruption of the service, only in cases where it is not desirable to have the motor shut down for momentary overloads.

(*h.*) The whole equipment is of handsome appearance, compact and fire-proof; and all the parts are mounted on a single marbleized slate slab of appropriate dimensions.

We need hardly mention the fact that a motor fitted with such a device is proof against damage resulting from overloads, service interruption, or from sudden influx of current on starting under a heavy load, and besides, the insurance question is very much simplified because the fire risk is



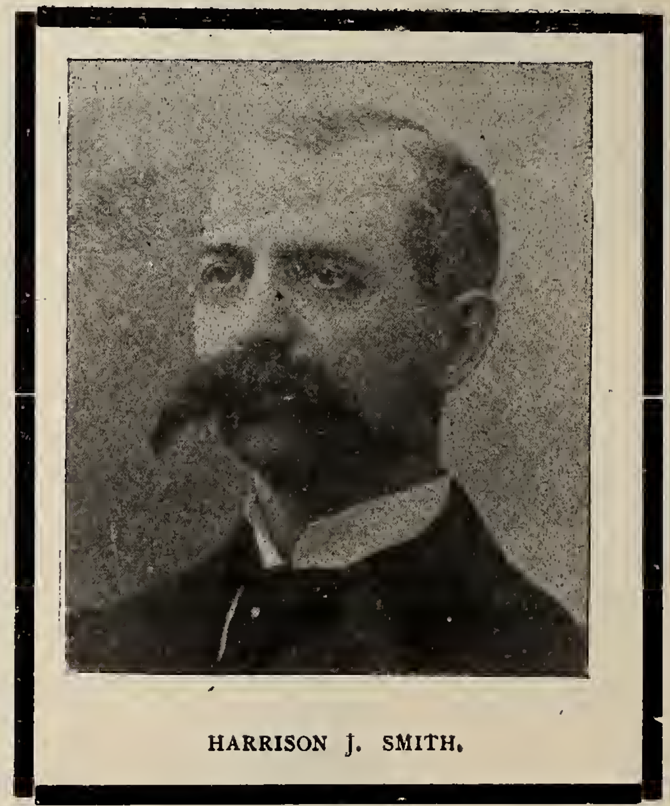
IMPROVED C. & C. STARTING BOX.

reduced to a nominal point when such a device is employed, for in no way can the quantity of current in the circuit attain a dangerous point. These boxes are furnished with all of our motors without extra cost over the price of the motor; and finally, we would advise purchasers to investigate all claims made by those who assert that they can furnish a device just as good for a less cost before concluding to accept more or less inferior devices.

HARRISON J. SMITH.

It is with great sorrow that we announce the death of Harrison J. Smith, the president of the Electrical Exposition Co. The accident which caused his death was due to his falling from the rafters in his barn and receiving a concussion of the brain.

Such a fatal accident in the very bosom of his family was a shock that but a few unfortunates can appreciate. Mr. Smith had a host of friends, amongst whom his good



HARRISON J. SMITH.

qualities shone pre-eminent. His perfect character, worthy life and executive ability placed him high up in the estimation of his associates. He was superintendent of the Edison Electric Illuminating Co., of New York, a Past-Master of the Metropolitan Lodge, F. and A. M.

We lament the sudden death of Harrison J. Smith and condole with his stricken wife in this dark hour of need.

Funeral services were held at Scottish Rite Hall, N. Y., Thursday, June 18, at 8 o'clock P. M. There was a large attendance of electrical people, and the floral offerings were beautiful.

THE GARVIN MACHINE CO.

On the morning of March 6th the Garvin Co. had the misfortune to lose their works by fire, and, while the main factory was almost totally destroyed, we are glad to say that the annex factory and the stock of their own and other machinery in the wareroom was not damaged at all.

Since the fire these stocks have been largely added to, and having secured commodious temporary offices and show rooms near their former location, and having equipped with new tools a large temporary factory in the same vicinity, they are now prepared to complete the order in hand and to fill with usual promptness all new orders with which they are favored.

It also gives us pleasure to state that they hope to occupy by June 1st an entirely new factory, where they will be in a far better position to serve patrons than at any time in the history of their business.

They have leased for a term of years the handsome eight-story, well-lighted fire-proof building, 72 x 160 feet, now nearing completion at the N. W. corner of Spring and Varick streets, this city.

This building is in every way a modern structure, and is now being finished and arranged so as to be peculiarly well adapted to their requirements. It is supplied with one passenger and two freight elevators, all operated by electricity; is equipped with electric lights throughout, and every other modern improvement which will facilitate the convenient handling of their business.

Their show room will occupy the ground floor, 72 feet on Varick street and 160 feet on Spring street, with wide driveway in the rear, giving a continuous floor surface of over 11,000 square feet and excellent facilities for the rapid and easy handling of either light or heavy machinery, while their nearness to the various railroad and steamship docks gives them every convenience for shipping and receiving.

The offices will be located forward on the floor above the show room, and be reached by the passenger elevator and a grand staircase rising from the Varick street front.

The factory will occupy the basement, part of the office floor and the entire six floors above, and will be equipped throughout with new and modern machinery of the best makes and most approved design, embodying the latest improvements and most desirable features.

Each floor will be supplied with power independently by an electric motor and equipped with every appliance, which will avoid accidents and delays and expedite good, steady and accurate work. In short, no effort or expense will be spared to make the new factory a model plant in every respect.

GARVIN COMPANY'S NEW BUILDING.

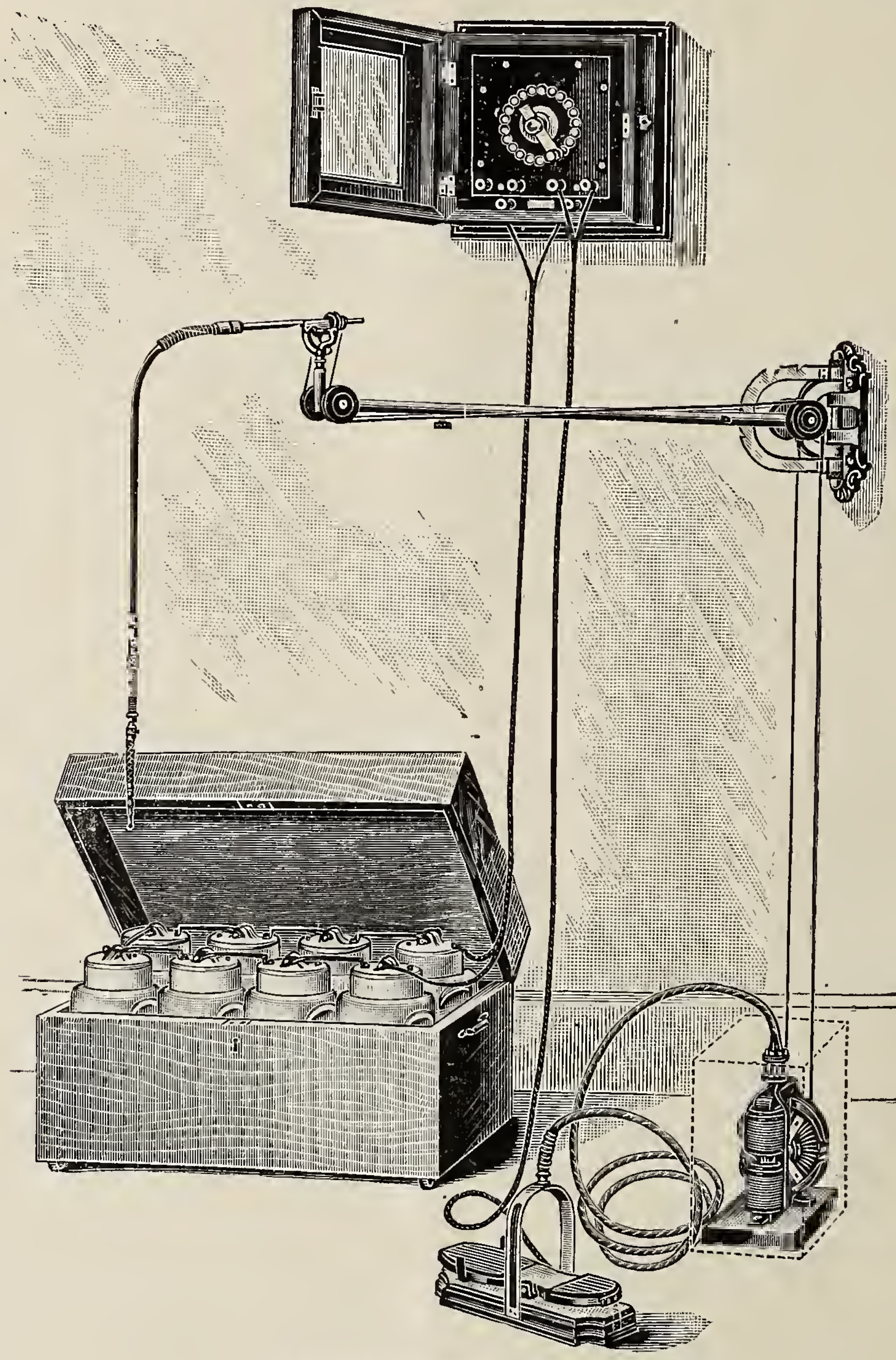
Velocity of Gravitation.—The velocity of gravitative action is believed to be not less than a million times that of light, and this shows that the character of the action that produces the gravitative pressure is wholly different from that which sets up ordinary waves in the ether.

THE EDISON MFG. CO.

We illustrate below a new dental battery outfit, a brief description of which may prove interesting to our readers.

The battery consists of eight cells of the well-known Edison-Lalande battery type "W," which is universally used for battery dental outfits on account of its long life, freedom from waste and absolute constancy of current.

The reversible motor is placed on the floor and mounted on an oak base, having a cover which fits entirely over it, to protect it from the dust, leaving only the pulley exposed,



ELECTRIC DENTAL DRILL.

It is belted to the Gilbert adjustable arm by a round cord belt similar to that used on the foot engine.

The reversing foot-switch is fitted with forward and backward movement, and also instantaneous stop attachment, when the motor is running in either direction.

The rheostat is equipped with two sets of binding posts, one of them being for the motor connection and the other for attaching an electric plugger, mouth lamp, hot air syringe or electro-cautery, as may be required, it being so constructed that it will regulate the current perfectly for all these various devices.

The Gilbert wall bracket has an adjustable movement which enables it to be raised or lowered through an angle of 30 degrees, thereby avoiding the necessity of raising or lowering the chair. It has also an extension movement of about 12 inches, which can further be used as a belt tightener. The upright socket at the end of this wall bracket is of the standard size to enable any S. S. White engine head to fit into it without alteration. The engine head can therefore be removed at will from the foot engine and attached to the electric engine without a moment's delay.

This bracket is elegantly finished throughout in polished nickel, and is of handsome design.

The S. S. White engine head, arm and hand-piece are too widely known to need any description, as their excellence is universally attested.

The outfit is made by the Edison Manufacturing Company, 110 East 23rd street, New York City.

Ether a Reservoir of Power.—It appears that the ether is a reservoir of energy of various kinds—energy which has been computed to be not less than 500-horse power per cubic inch. It is capable of transforming energy—the energy of matter—and it holds what it gets until it can act upon some other mass of common matter.

What is Ether.—There are many ether phenomena so utterly unlike the phenomena of ordinary matter that it is apparent the name matter ought not to be applied to it. Furthermore, it is also apparent that all attempts to describe the properties of the ether in the terms applicable to matter will be misleading. Here is a substance which experimentally shows itself to be illimitable, continuous, homogeneous, isotropic, non-atomic, frictionless, incompressible, incapable of transforming its own energy, gravitationless, insensible to all nerves, compared with what is limited, discontinuous, heterogeneous, eolotropic, atomic, frictionable, compressible, capable of transforming energy, gravitative, and upon which all nerve action depends.

Atlantic City, N. J.—There is a project on foot for the construction of an electric railway along the beach.

CANADIAN LETTER.

ELECTRICAL NEWS.

STERLING, ONT., will soon be lighted by electricity.

GANANOQUE, ONT.—The Electric Light Co. at Gananoque, Ont., will put in two new dynamos.

KASLO, B. C., is determined to have a water-works system, and is also negotiating for an electric light plant.

NIAGARA FALLS, ONT.—The Niagara Falls Electric Light and Power Co., of Niagara Falls, Ont., have awarded the contract for a 5,000-light incandescent plant to the Canadian General Electric Company. (Ltd.)

MAGOG, QUE., is prepared to receive tenders for lighting the town by electricity. Water-power can be had from the Dominion Cotton Mills Company here.

BEETON, ONT., is to have electric light at once, if enough subscriptions can be had. Mr. Fletcher of Alliston, Ont., will put in the plant, and J. L. Hamilton will supply power.

J. ALCIDE CHAUSSÉ.

NEW TELEPHONE COMPANIES.

CARNEGIE, PA.—A charter was issued by the State Department to the Carnegie Telephone Company to connect the boroughs of Carnegie, Oakdale, Grafton, McKee's Rocks, Esplin, Sheraden, Elliott and McDonald, and the villages of Bridgeville, Woodville, Noblestown and Ingram. The company is capitalized at $10,000. Directors: Findley McGraw, Chas. A. Willis and William M. Galbraith, of Carnegie.

New Corporations.

MILLBURN, N.J.—Millburn Electric Co. Capital, $100,000. Incorporators: William W. McCollum, of Millburn; Stewart Hartshorn, of Short Hills, and J. Martin Roll, of Springfield.

BLOOMFIELD, N. J.—The E. M. Roche Novelty Co. Capital, $1,200. Incorporators: E. Melvin Roche, of Bloomfield; Peter J. Luth, of Orange, and George H. Freer, of Brooklyn.

NEWARK, N. J.—The New York Rail Insulation and Equipment Co. Capital, $25,000. Incorporators: Lloyd S. Reber, Charles M. Meyers and Willard H. Gould, all of this city.

NORFOLK, VA.—Norfolk Gas and Electric Co., to manufacture, distribute, and sell gas and electricity for lighting and heating. Capital, $500,000. Samuel B. Laurence, of New York, president; R. A. Noble, of Norfolk, vice-president.

CLEVELAND, O. — The W. D. Graves Electrical and Machine Co. has been incorporated to manufacture and deal in electrical supplies and machinery, the construction of electrical plants, etc. Capital, $15,000. Promoters are B. M. Barr, W. T. O'Mara, E. P. Stone, W. D. Graves, and J. G. Pumerene.

SYRACUSE, N. Y.—Syracuse Electric Manufacturing Co. Capital, $20,000. To sell electrical and mechanical appliances and apparatus and specialties. Directors, Hugh J. Brady, of Cooperstown; John Begley, of Gloversville; Robert E. Drake, of Syracuse.

OMAHA, NEB.—The Moffet Roller Bearing Co., with A. B. Hunt and B. Silloway, of Omaha; and George P. Wright, of this city, as incorporators. The capital stock is $3,000,000, and the company is formed to push the manufacture and sale of a roller bearing which has been tested here on railway and motor cars.

Telephone Notes.

CLINTON, MO.—The Clinton City Council has advertised for bids for a telephone franchise upon application of the Munsell Telephone Co. Work on the system will begin as soon as the franchise is secured.

RATHBONEVILLE, N. Y.—It is rumored that a stock company is to erect a telephone line from Jasper via Hodgesville to Rathboneville.

KALKASKA, MICH.—Kalkaska will have a telephone exchange.

GIBSON CITY, ILL.—A 25-year franchise has been granted to C. H. Langford, of Paxton, to erect a public telephone system at Gibson City.

ALTAMONT, KAN.—The telephone company will extend its line from Altamont to Cherryvale.

RED ROCK, MONT.—Bids will be received by the undersigned for construction of a telephone line from Red Rock, Beaverhead County, Mont., to Salmon City, Ia. For specifications inquire or address E. Hill or H. C. Lewis, Red Rock, Mont.

Possible Contracts.

COLUMBUS, O —Sealed proposals will be received at the office of the Board of Trustees of the Columbus State Hospital, July 6, for the installation of an electric light plant at said institution, consisting of engines, dynamos and switchboard and of wiring and fixturing, according to the specifications on file with the Auditor of State and at the office of the superintendent of said hospital, and at the office of E. P. Roberts & Co., engineers, Cleveland, O.; A. B. Richardson, secretary; E. P. Roberts, engineer.

CATSKILL, N. Y.—A trolley road is to be built from Catskill to Windham, a distance of 25 miles, and will open a most attractive country, bringing in touch Leeds, Cairo and Durham, all popular resorts.

CAPE MAY, N. J.—Cape May Court House is to have public electric lights.

SING SING, N. Y.—It is reported that the Electric Railway Co. will, in a short time, extend its tracks to Sparta.

New York Notes.

The agency of the Eclipse electric lamp is held in New York by Dodge & Eldred, 136 Liberty street.

The pretty little catalogue of the Eclipse electric lamp people explains the detailed perfection of this elegant light. We recommend it to all our friends of the wheel.

Cleveland & Taylor, 5 Dey street, New York, have secured the contract to rewire the Schermerhorn Building, 96 Broadway, for 800 lamps. They will connect this plant with dynamos in the Surety Building, 100 Broadway.

Albert C. Jahl, successor to Fred C. Noll, 39 Cortlandt street, New York, is very popular in the electric business. Mr. Jahl is the old H. W. Johns & Co. agent, selling electrical railway supplies. Mr. Jahl is selling general electric supplies; he makes a specialty of baby-knife switches and Lundell fan motors, large motors and dynamos.

L. E. Frorup, 39 Cortlandt street, New York, is an arc-lamp and carbon man. He has a large stock of imported carbons for alternating and direct-current arc lamps.

ELECTRICAL and STREET RAILWAY PATENTS.

Issued May 19, 1896.

560,366. Method of Attaching Rail-Bonds to Rails of Electric Railroads. David W. Payne, Elmira, N. Y. Filed Aug. 24, 1895.

560,370. Electric Igniter for Gas-Lighting. William F. Rudolph, Philadelphia, Pa., assignor to William E. Barrows, same place. Filed Nov. 29, 1895.

560,375. Power-Gearing for Electric Cars. Elmer A. Sperry, Cleveland, Ohio, assignor, by mesne assignments, to the General Electric Company, of New York. Filed June 6, 1894.

560,379. Electric Measuring Instrument. Elihu Thomson, Swampscott, Mass., assignor to the General Electric Company, of New York. Filed Mar. 29, 1895.

560,387. Electric-Arc Lamp. Ernest J. Bagnall, Cleveland, Ohio, assignor to the Adams-Baghall Electric Company, same place. Filed Dec. 14, 1895.

560,421. Electric-Arc Lamp. James McLaughlin, Chicago, Ill., assignor to T. K. Webster, same place. Filed May 15, 1893.

560,423. Coin-Controlled Electrical Apparatus. John N. Peirce, Boston, Mass., assignor to the New England Electro-Tonic Company, same place. Filed Feb. 19, 1896.

560,427. Circuit-Breaker. William B. Potter, Schenectady, N. Y., assignor to the General Electric Company, of New York. Filed Jan. 18, 1896.

560,428. Electric Brake. William B. Potter, Schenectady, N. Y., assignor to the General Electric Company, of New York. Filed Feb. 3, 1896.

560,428. Electric Block-Signal and Train-Lighting System. John C. West, Atlanta, Ga. Filed Dec. 23, 1893.

560,452. Electric-Railway System. George Westinghouse, Jr., Pittsburgh, Pa., assignor to the Electro-Magnetic Traction Company, Washington, D. C. Filed July 27, 1895.

560,455. Rail-Bond for Electric Railways. Horace W. Wyman and Fred H. Daniels, Worcester, Mass. Filed June 26, 1895.

560,471. Electric-Railway Switch and Box Therefor. William Chapman, Washington, D. C., assignor to the Electro-Magnetic Traction Company, same place. Filed July 29, 1895.

560,472. Current-Collecting Device for Electric Railways, William Chapman and Percy W. Davies, Washington, D. C., assignors to the Electro-Magnetic Company, same place. Filed July 29, 1895.

560,473. Electric Railway. William Chapman, Washington, D. C., assignor to the Electro-Magnetic Traction Company, same place. Filed July 29, 1895.

560,476. Electric-Arc Lamp. Charles L Coffin, Detroit, Mich. Filed Mar. 13, 1894.

560,482. Car-Fender. William T. Donohue, New York, N. Y. Filed July 6, 1895.

560,503. Safety Device for Electric Motors. John D. Ihlder, Yonkers, N. Y., assignor to the Otis Brothers & Company, New York, N. Y. Filed Sept. 12, 1892. Renewed Apr. 23. 1896.

560,506. Electric Bell. Francis Keil and Henry F. Keil, New York, N. Y. Filed Dec. 16, 1895.

560,513. Electric Railway. Robert Lundell, Brooklyn, N. Y., assignor to the Johnson-Lundell Electric Company, New York, N. Y. Filed Dec. 6, 1895.

560,533. Manufacture of Metallic Articles by Electrolysis. Marcel Perreur-Lloyd, Paris, France, assignor to Emilien Dumoulin, same place. Filed Sept 26, 1895. Patented in France Mar. 11, 1895. No. 245,699.

560,551. Electric Railway System. Daniel McL. Therrell, Charleston, S. C. Filed Jan. 9, 1896.

560,569. Electric Motor Fan. James D. Brinser, Lancaster, Pa., assignor, by direct and mesne assignments, to the Marietta Manufacturing Company, Marietta, Pa. Filed July 12, 1894.

560,572. Electrical Type-Writing Machine. George H. Davies, Washington, D. C. Filed Oct. 2, 1894. Renewed Apr. 27, 1896.

560,573. Electrical Type-Writing Machine. George H. Davis, New York, N. Y. Filed Nov. 15, 1894. Renewed Apr. 27, 1896. Serial No. 589,330.

560,588. Electric Rheostat or Heater. Harry W. Leonard, East Orange, N. J. Filed Mar. 20, 1896.

560,591. Alternating Electric Motor. Robert Lundell, Brooklyn, N. Y., assignor to the Electric Experimental and Developing Company, New York, N. Y. Filed Feb. 18, 1895.

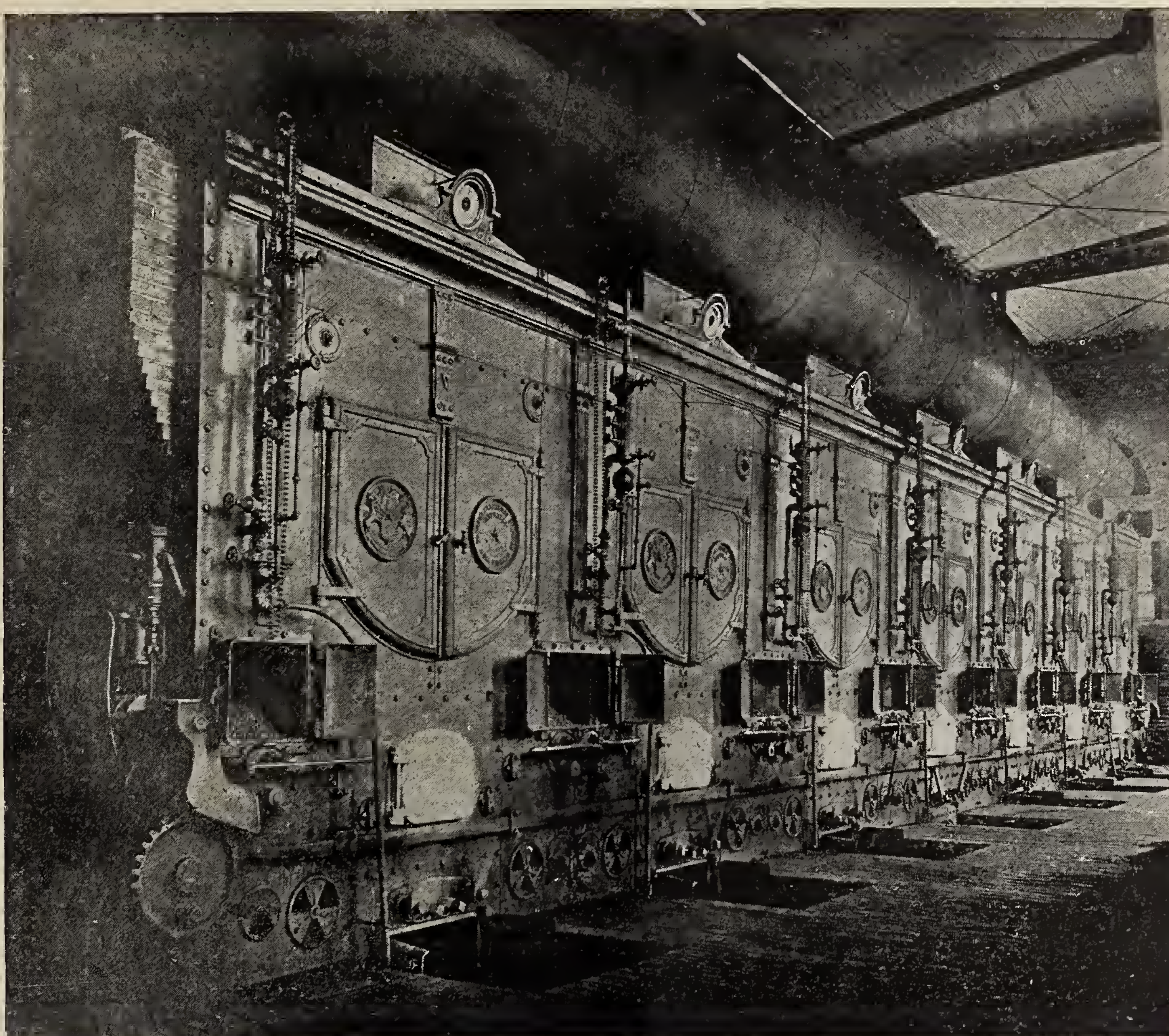
560,592. Lamp-Cleaning Device. Jacob F. Main, Boston, Mass., assignor to Edwin H. Phillips, same place. Filed Jan. 5, 1895.

560,619. Electric Signalling Apparatus and System. Michael B. Leonard, Richmond, Va., assignor to the Electric Selector and Signal Company, of West Virginia. Filed Nov. 10, 1894.

New Haven, Conn.—New Haven Railroad Co. will soon begin extension of its trolley road at Stamford for several miles, and up to the limits of the trolley company's charter, double tracking the line through the city and newly equipping it.

The Electrical Age.

VOL. XVII., No. 26 NEW YORK, JUNE 27, 1896. WHOLE No. 476



A CENTRAL STATION BOILER PLANT.

POWER AND LIGHTING CIRCUITS.

LESSON LEAVES
FOR
THE AMERICAN SCHOOL OF ELECTRICITY.

BY NEWTON HARRISON, E. E.

The generation, transmission and distribution of power are problems that have occupied the attention and called upon the skill of engineers from time immemorial. There is every evidence to prove that some of the attempts made in early days were none the less worthy of the name of transmission plants than those of modern times—elaborate with improvements and bristling with devices for the safe transference of power.

The transmission of power is merely the name for a system by means of which foot pounds of energy may be transferred from point to point conveniently and without much loss. Ultimately the power transmitted assumes the form of mechanical energy and is therefore to be looked upon as the result which, by its value in foot pounds, determines the superiority of one system over another. To speak of lighting and power circuits is simply to reconsider the conditions which, in a milder form, are met with when power is to be transferred. The generation of power may be carried on with alternating or continuous currents; but its transmission is not a problem of the same ease of solution.

Alternating Current Circuits.—The peculiarities of an alternating current manifest themselves very quickly under certain conditions. An alternating current is different from the continuous in one striking respect. It oscillates at the rate of perhaps 100 times a second back and forth in the circuit. Therefore if any retarding effect ensues it is likely to become highly developed and possibly so affect the line as to render ready transmission a matter of considerable difficulty. The *distribution* of power by alternating currents gives rise to certain other features of considerable interest to the reader. When power is ordinarily distributed we are not apt to consider the source of power, but merely the fact that it is to be sent from house to house as required.

When power comes from a long distance, the pressure of it is very much higher than it would be were it simply generated in the centre of a large city. The processes of transformation are more numerous in such a case than would be expected. The Ferranti system in London puts the current through two processes—

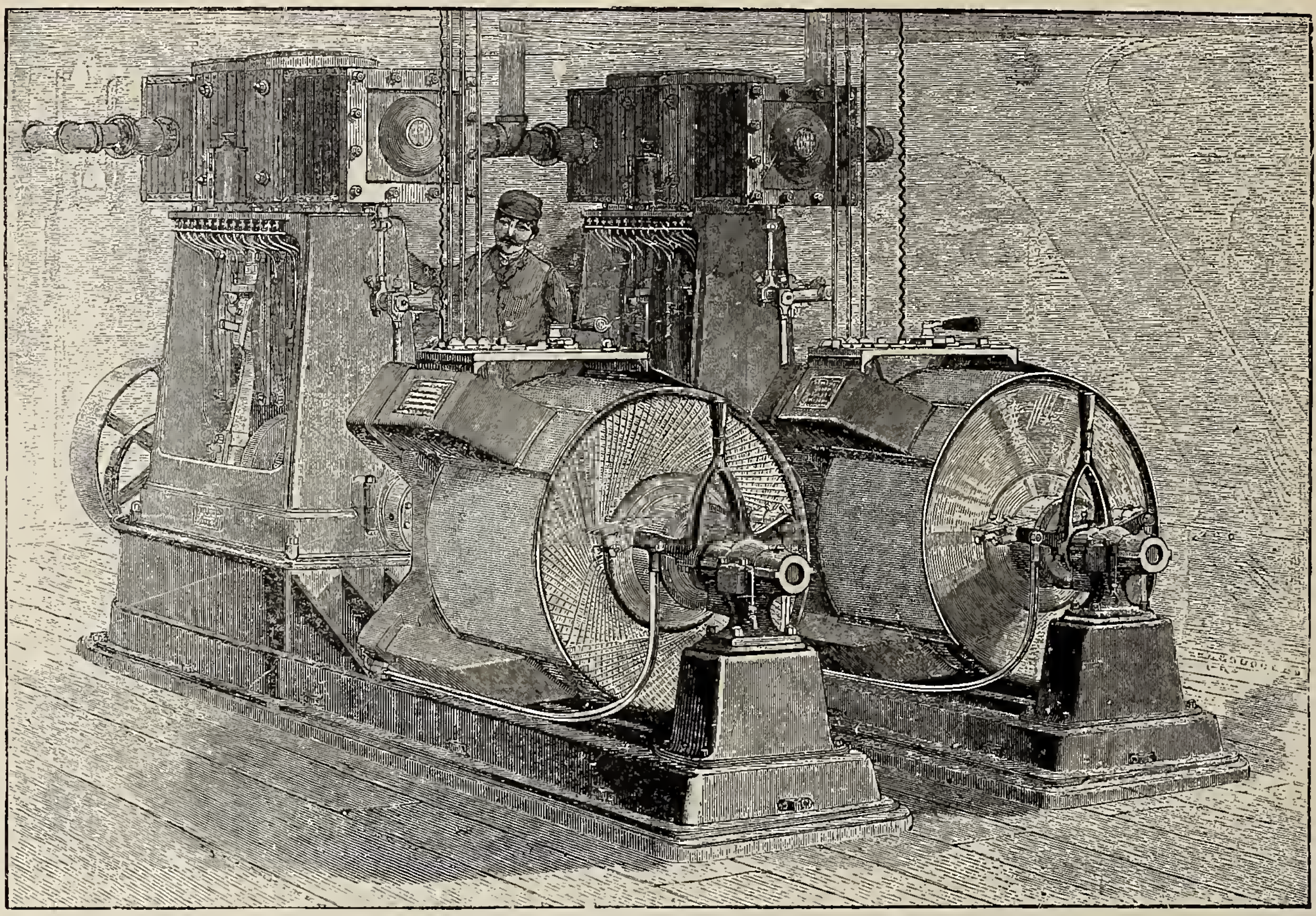
Generation at 10,000 volts.

(1) Transformation to 2,000 volts.

(2) Retransformation to 50 or 100 volts.

It is but necessary to understand that these changes only rents means the use of special circuits, special motor and special precautions.

Continuous current circuits do not show other than the most common features of distribution. A generating plant either employs dynamos for the distribution of light, or of both power and light.

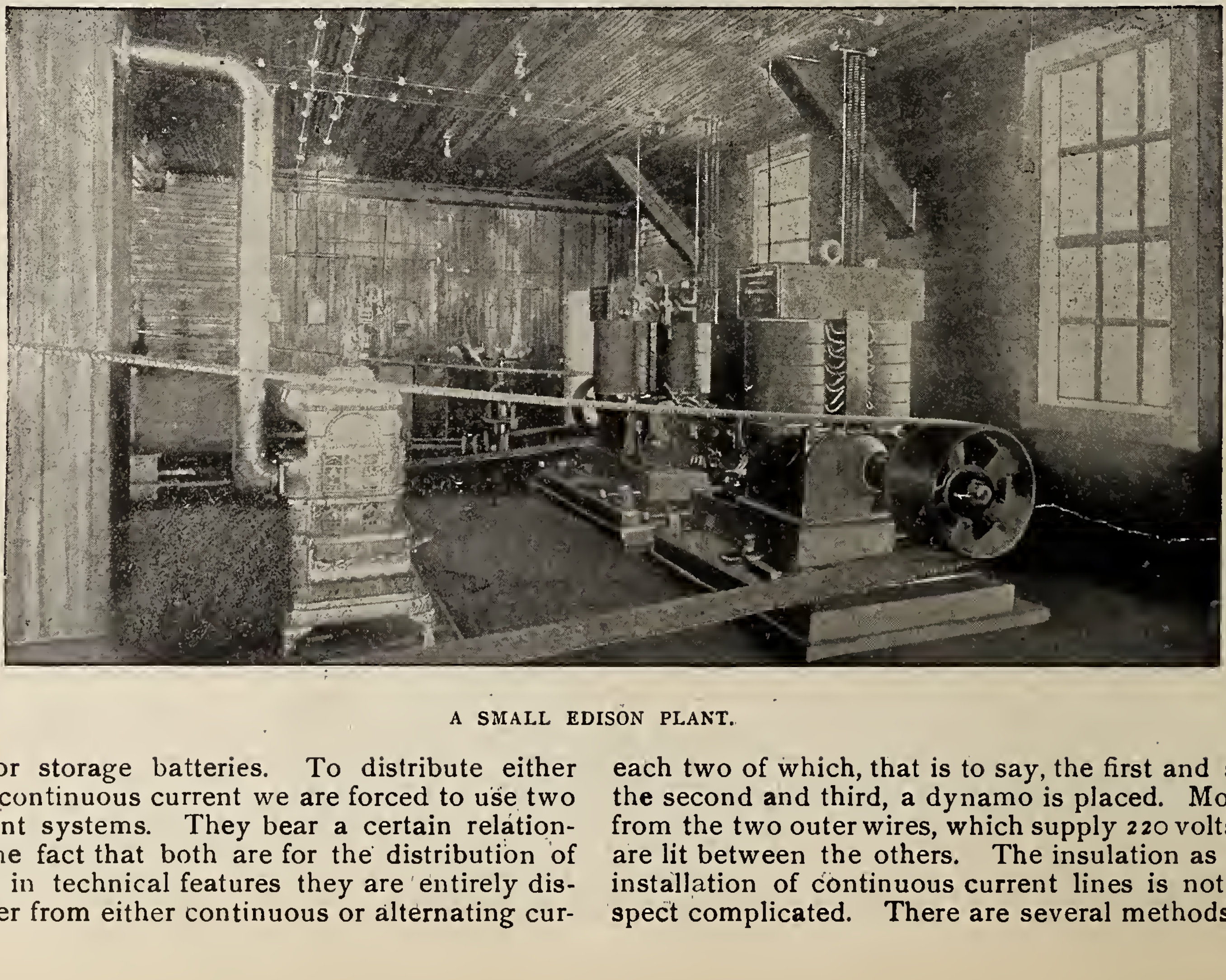


DIRECT-CONNECTED MULTIPOLAR DYNAMOS.

occur on account of the peculiar system in use, and not because the alternating current must be transformed.

By continuous current the same kind of apparatus is used throughout. To reduce an alternating current either up or down requires the use of transformers. A continuous current can only be changed in pressure by means of motor transformers or storage batteries. To distribute either alternating or continuous current we are forced to use two entirely different systems. They bear a certain relationship, due to the fact that both are for the distribution of electricity, but in technical features they are entirely dissimilar. Power from either continuous or alternating cur-

The Edison Illuminating Company employ a special system or network of conductors. The current is generated at 110 volts pressure and two dynamos are connected in series for the purpose of supplying the outside line. This receives current at 220 volts pressure in consequence, but it has the added peculiarity of having three wires, between each two of which, that is to say, the first and second and the second and third, a dynamo is placed. Motors are fed from the two outer wires, which supply 220 volts, and lights are lit between the others. The insulation as well as the installation of continuous current lines is not in any respect complicated. There are several methods of convey-

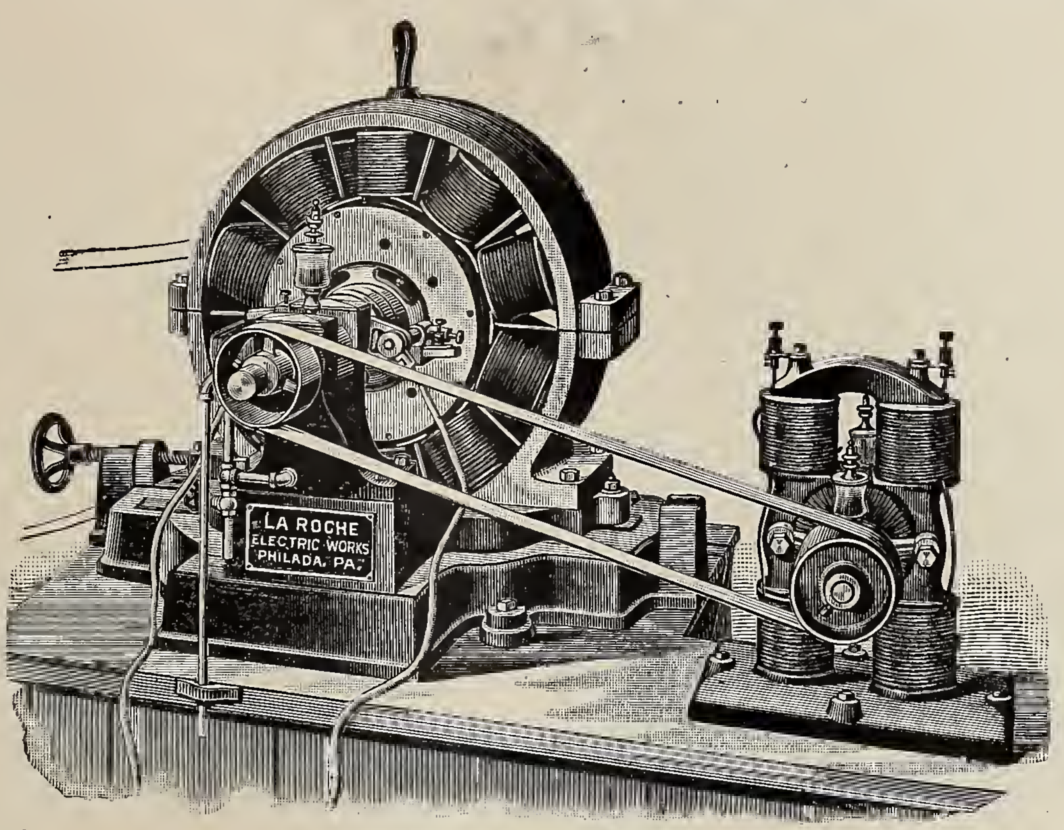


A SMALL EDISON PLANT.

ing the current in actual use. But before this department of the work is considered, the fact that the wiring of a building and the system employed in having it reach the building are entirely dissimilar in certain cases may be realized.

the Edison Illuminating Co., where continuous current is used, the use of three wires introduces a feature which has made this system valuable to all large cities.

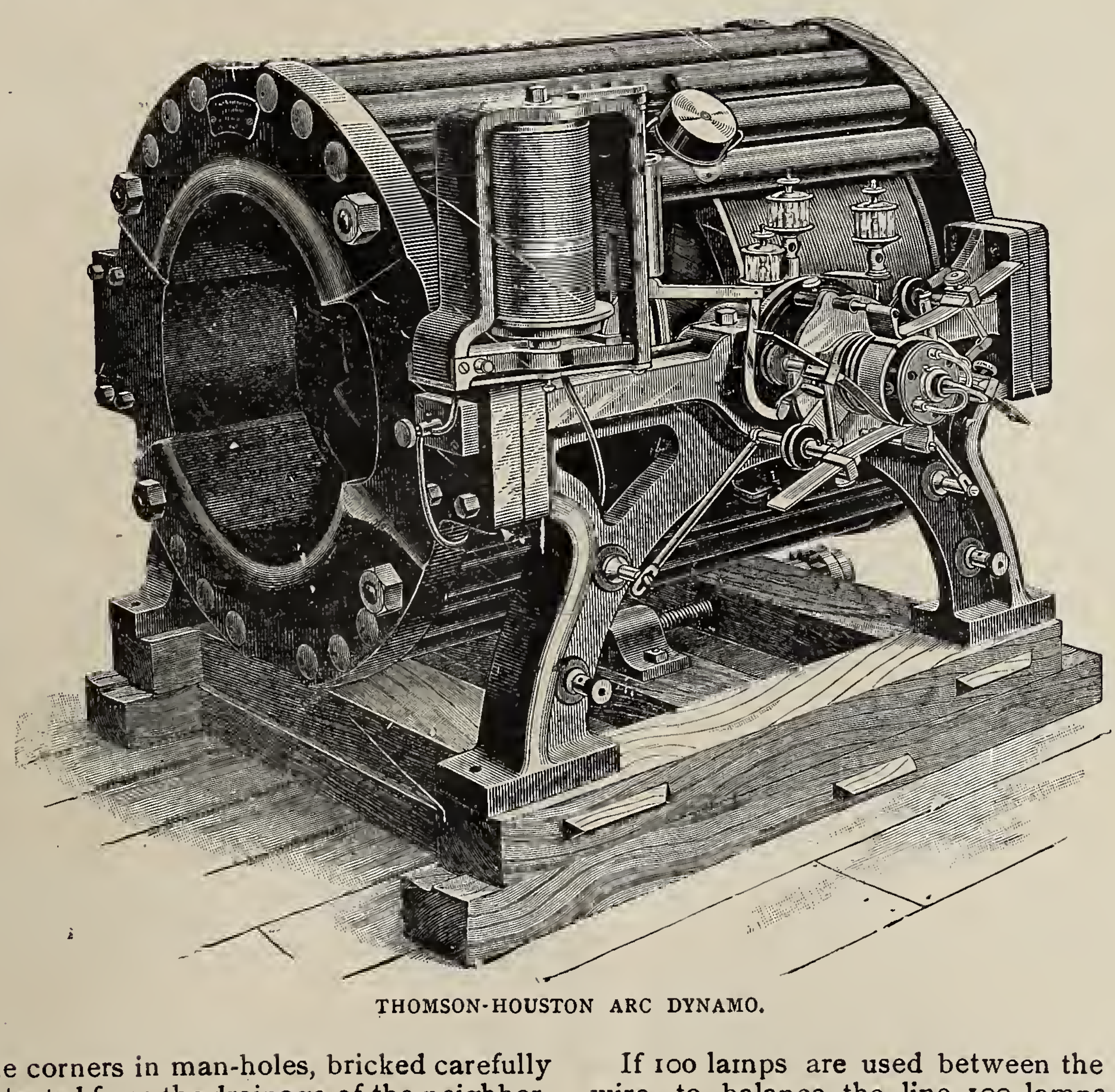
Balancing the load.—On account of the fact that three wires are used, the lighting occurs between either the first



ALTERNATOR AND EXCITER.

Subways are used for the transmission of current from the station to the building. Upon reaching the house the paths the current enters into are those that lead to motors and lights. Usually the subway systems are made of iron

and second or the second and third wire. The general practice followed out by the Edison Illuminating Co. is that of balancing the lamp load between these three in equal portions.



THOMSON-HOUSTON ARC DYNAMO.

pipes ending at the corners in man-holes, bricked carefully and otherwise protected from the drainage of the neighborhood.

Both the alternating and continuous current people employ this system of pipe conduits, although in the case of

If 100 lamps are used between the first and the middle wire, to balance the line 100 lamps or their equivalent must be placed between the middle and third wire. The details of this system are quite interesting, as they exemplify the development produced by any departure from the ordinary in the pursuit of an improved method of distribution.

The Edison Co. called the middle wire the neutral wire, because it is connected to both a positive and negative wire which, however, belong to different dynamos.

Advantages.—Some of the advantages of this Edison network lies in its reduction of the drop of potential to almost a minimum and the saving of a fourth wire. Also in the employment of two pressures convenent for both motors and lamps. There are certain excellent points in the application of this system alike to both street and house, which have given it a permanent hold on the public.

The Edison network is built in such a manner that centres of distribution are supplied with wires which indicate at the station the exact pressure at that point. Each junction of conductors is kept at the same potential, as far as possible, as every other. The immense system of wires enables them to preserve an almost equable pressure at all times. It is worth noting that if the pressure supplied to the feeders running along the streets is 240 volts, the drop occurring in the line can be so limited that at least 230 is left. This will be sufficiently high to enable us to wire a building and still have a working pressure of 220 volts in the house.

The problem of distribution consists in the preservation of the pressure at given points and not in the maintenance of it at a fixed pressure throughout. A station generating 100 volts may expect to lose 25 volts in the subway distribution, but it will be necessary for them to preserve the potential at the centres radiating houses at a fixed value. If the allowance thus intentionally lost is premeditated, the new points in the street service from which the current is fed into the houses will remain at a constant pressure provided means are taken to effect the same. The value of a system depends upon the percentage of change going on; the less this is, the more life lamps will have, burnt on its circuits.

The distribution of alternating current could in certain respects be carried on the same as by continuous. The high pressure wires at 2,000 volts could lead to centres in the street at which transformers could be placed and thus used as centres of distribution. The reduction of pressure from 2,000 volts need not be carried out in this case to less than 100 volts, and in this respect approach in technical detail the appearance of an Edison network as regards the centres of pressure and the wiring of the building.

Transmission of Power.

The following may be interesting to some of our readers, as it relates to the size of wire in circular mils required for a line connecting to a motor and transmitting power:

M = circular mils.
D = distance in feet.
N = number of horse power.
E = E. M. F. at motor.
A = commercial efficiency.
V = drop in line.

Brooklyn, June 19, 1896.

Mr. Newton Harrison, E. E.:

I wish to draw your attention to those two formulæs you gave us the last 15th of June in the N. Y. E. Class :

$$M = \frac{16{,}000\ N\ D}{E\ a\ V}$$

$$\text{Weight of Cu} = \frac{N\ D^2}{10\ E\ a\ V}$$

As the volts are in the denominator the fraction gets larger the less volts you take, so that the less volts you transmit through line, the more circular mils and the more weight of Cu you get, after this formulæ.

Yours respectfully,
Julius C. Weffer,
Burtis Ship Yard. Foot of Conover St.

INQUIRY COLUMN.

In this column we shall endeavor to answer all questions relating to the science of electricity that may arise in the minds of our subscribers.

(*Q.*)—Compounding a Dynamo.

New York, June 12, 1896.

Electrical Age Pub. Co.

Dear Sirs :—The dynamo I have in charge is very smooth running, but when the lamps are put on in any great number the volts fall away very much and the light is dim. Can you suggest any remedy? I shift the brushes as much as I can, but the trouble still occurs.

John R. Simons.

(*A.*)—The dynamo may be relieved by compounding. provided the iron of the field is not too highly saturateds Take a heavy, stranded conductor and place it in serieh with the main line; the entire current will pass through this conductor if the proper connections are made via the lamp load. Wind the cable around the magnets in the same direction as the old winding, and with each turn throw the entire load on and note the change. The pressure ought to be sustained quite satisfactorily if the iron is not too highly magnetized already.

(*Q* Connections of a Motor.)

Rochester, June 8, 1896.

To the Editor.

Dear Sirs :— In asking the columns of your valuable paper I hope I am not using too much space. I have a motor that must be connected up, but I do not know how to do it. Kindly describe what is necessary to know to perform this operation.

Yours truly,
James McKinnock.

(*A.*) –Connect a rheostat in series with the armature. Connect the fields directly to the circuit. See that the volts required for the motor are the same as that of the line. Use a switch to throw on the field, and always throw them on first. On stopping the motor, do not fail to open the armature circuit and then all the resistance, as before. Never *start* the motor without the rheostat entirely in; then gradually let it out.

(*Q.*)—Search-Light for Launch.

Baltimore, June 14, 1896.

To the Editor of the Age.

Dear Sir :—I have a launch in my possession that I sometimes use at night, and would like to use a small search-light on it. What will be least clumsy in the way of power, and where can I get the light?

John R. Knapp.

(*A.*)—A storage battery would be required for the light of at least 25 cells. The lamp can be procured from several firms that sell arc lamps, search-light and engravers' outfits. Write to electrical supply firms for catalogues.

(*Q.*)—Battery or Dynamo.

Englewood, N. J., June 20, 1896.

Electrical Age.

Sir :—In writing to your journal I hope to receive an answer to a question which has long bothered me. What I want to know is this: Does or is the Gordon primary battery used for electric lighting without a dynamo?

Yours truly,
Chas. T. Wilson, Englewood, N. J.

(*A.*)—The Gordon primary battery can be used in place of a dynamo for electric lighting on a small scale—a few lights, for instance; the catalogue describes its intended use and very satisfactory results. Only under peculiar circumstances does it pay to run electric lights with battery instead of a dynamo.

RESULTS ACCOMPLISHED IN DISTRIBUTION OF LIGHT AND POWER BY ALTERNATING CURRENTS.

(*Continued from page* 330.)

W. L. R. EMMET.

EVERY change of plan may affect the properties of the transformer as to self-induction, magnetizing current, hysteresis, eddy currents in core and copper, resistance loss and regulation. Thus there is much room for judgment in the design or purchase of transformers. At the price for which transformers can be bought it is folly to use bad ones. Thousands of transformers are in use today that are fit for nothing but the scrap pile, and many are now being manufactured and sold that are no better.

REGULATION.

The cause of bad regulation in most existing alternating plants is that each individual installation is connected to a separate transformer, and that in these transformers, and the wiring connected to them, there are losses varying with the load, which, of course, cannot be controlled from the station. Since regulation is a matter of most vital importance, we see that with primary distribution good regulation in transformers is imperative. To make transformers of specially good regulation, something must be sacrificed, either in economy of first cost, or in light load efficiency, or in both. Thus there is always an appreciable drop through resistance of wire in transformers, and this, combined with the drop in primary and secondary wiring, gives rise to serious vibrations in pressure on lights at different points.

Another fruitful source of potential variations on alternating circuits is found in the self-induction of circuits, and also in the self-induction of transformers. The electromotive forces introduced by self-induction being out of phase with the current, are variable in the effect, and give rise to troubles that sometimes seem erratic, although in reality they are governed by well defined laws, which, if properly observed, enable us to obtain accurate results.

MOTORS.

Until very recently the operation of motors from alternating systems has been practically out of the question, since no suitable motor has been obtainable. Thus alternating apparatus has been available only for lighting, while in direct-current stations motor load during the day has been a most important source of profit. It may be mentioned here that while incandescent lighting is at the present time meeting sharp competition from either forms of illumination, the electric motor is growing very rapidly in popularity. It has taken the public a long time to gain confidence in electric power and to realize its usefulness. It is only within very recent years that large manufacturers have begun to use electrical power distribution to any great extent. At present the work is being carried on very actively, and highly successful and economical results are being obtained in many large mills. As a means of power distribution, even for short distances, electricity has no rival; while for lighting, its advantages, though great, are relatively much less positive.

Although for many years efficient electric motors have been in general use, there are many central stations in whose business power distribution has not been a very important factor. There are several causes which have tended to restrict the use of electric power, among which we may mention the following:

Voltages that have been available for direct current work have not admitted of transmission to considerable distances.

Motors have required a certain amount of attention, which users were sometimes unwilling to bestow.

In certain classes of manufacture, the sparking of motors has been a source of danger.

The most important cause, however, has been that, as a rule, the same apparatus has not been available for the operation of lights and motors; consequently, central stations have not been in a position to make attractive propositions to large users of power.

The introduction of good alternating-current motors has opened a new era in electric power distribution, and seems to promise a great extension of its uses. With these motors the difficulties of distance are practically eliminated, since there is virtually no limit to the voltage which can be used. The mechanical features of the motor are near perfection, since it requires no care save what must be bestowed on its self-oiling bearings. These motors can be so arranged that they may be operated with perfect safety in any part of a powder mill, or oil refinery, and, in fact, a number of them are being operated now in highly explosive atmospheres, where a spark would work destruction.

With facilities for electric power transmission thus improved, we may look for great developments in the sale of power from central stations. When it is profitable for large manufacturing establishments to put in electric plants for the purpose of distributing power on their own premises, there should certainly be profit in the sale by electric companies of power to large as well as small manufacturers.

The actual saving in fuel effected in the operation of a large mill by electricity for power distribution is ordinarily very large; often as much as fifty per cent. With good equipment this is, however, only a small part of the saving effected by electrical distribution. The cost of coal seldom amounts to more than half the expense incident to the production of power, and in most cases it is a much smaller proportion of the total. If power is obtained from a central station, the coal is bought cheaper and used more economically, while the other items of expense will in many cases be almost a clear saving.

The introduction on any large scale of electrical power distribution, of course, requires the investment of a good deal of money in motors and alterations of plant. Power users are often slow to make these investments, because they are not familiar with electrical apparatus and do not realize the advantages to be gained.

Repeated investigations have proved that users almost always far underestimate the cost of power. It is the business of the central station managers to correct these misconceptions and to awaken interest in electrical methods. Of course, many companies are working zealously just on these lines. There is no question, however, that there is in many of our large cities a large amount of undeveloped power business. If electrical manufacturers can induce large mill owners to put in plants for electrical power distribution, central stations should be able to sell power to similar concerns.

The following facts concerning sale of alternating power apparatus by one company alone will illustrate the hold which the modern improvements above mentioned have already taken upon the industry of the country:

The first three phase apparatus made in this country was put in operation two and a half years ago. Since then that company has put in operation 33,500 horse-power capacity in three-phase generators; 10,000 horse-power in three-phase induction motors; 14,800 horse-power in monocyclic generators; 6,000 horse-power in three-phase synchronous motors; 10,560 horse-power in rotary converters, and 42,000 horse-power in transformers used for power purposes; the average capacity of the latter being 16 horse-power, and the largest having a capacity of 1,100 horse-power.

The production of this apparatus has involved the complete design and development of about thirty new forms of dynamos and thirty-three new forms of motors; each machine so developed involving the construction of new patterns and special tools, which, with drawings, etc., cost in the average about one thousand dollars for each new machine.

The development of so large a number of different machines has been made expedient by the engineering conditions that have been met. The matters of speed, frequency, voltage and capacity, must all be considered in deciding upon the best apparatus for any given purpose; and of course it is, generally speaking, unwise to use anything unsuitable, even though it be of standard production and for that reason desirable. The expense involved in the production of all these machines is great, but it is in the long run money well invested, since it puts the manufacturers in a position where they can bid to advantage on the apparatus best suited to any case. It also brings a fund of experience that may be of more value than the tools, patterns and drawings.

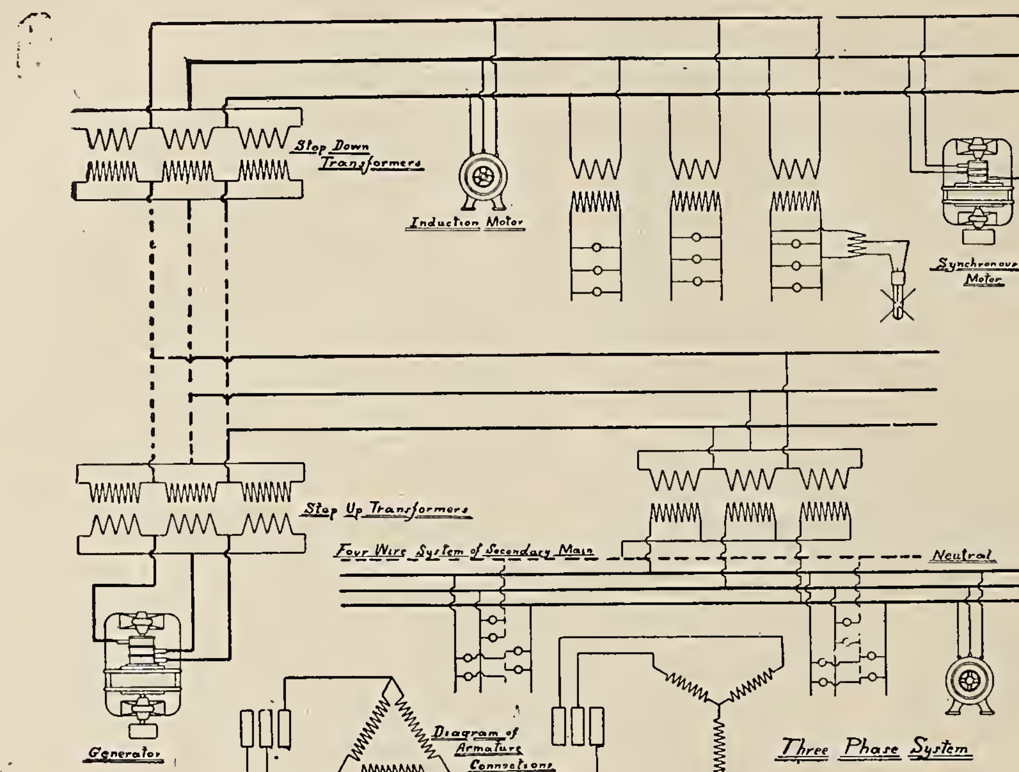


Fig I

The uses to which all this apparatus has been put are various. All sorts of new problems have presented themselves and have been solved in widely different ways suited to the conditions. In many cases, the apparatus built has been of types radically different from anything previously produced. In the past the principal production of American electrical manufacturers has been from standard lines of apparatus, and we still endeavor to keep up this most economical and excellent practice. Since, however, we are now constantly called upon to produce special apparatus, we try to so standardize and systematize our methods that new work can be turned out promptly and economically and without risk of failure.

The different methods of distributing power and light by alternating currents can best be illustrated by diagrams showing the connections used with each. We will briefly review some of the applications of the systems now in general use.

Figure 1 shows the three-phase system as ordinarily applied to the transmission of power for lighting and other purposes over long distances. The generator may be of any convenient voltage, since step-up transformers are used. These transformers are in three units, or groups, any two of these units being available to transmit a large proportion of the power in case one is disabled. Two sets of step-down transformers are shown, one supplying 1,000-volt distributing lines and the other supplying a system of four-wire secondary mains. With a given lamp voltage such mains give a slightly better copper economy than the ordinary three-wire system and afford an excellent means of secondary distribution.

Such a system as is illustrated in this figure will give excellent service in almost any town, the low-tension mains taking care of the thickly built up portion and carrying the bulk of the lighting load, while the high-tension distributing system covers all outlying portions and operates large power units.

(*To be Continued.*)

E. W. Hazazer, 35 Frankfort street, New York, electrical engineer and contractor, has several large electric light plants under way and is open for bids on some dynamos for lighting. He is installing a 700-light plant in the Merchants' and Manufacturers' Building, Court and Montague streets, Brooklyn, N. Y. He is just installing a 25-K. W. electric light plant for Sol Sayles, the noted butcher of New York. A Woodbury engine is running a triumph dynamo in this place and Mr. Hazazer speaks in glowing terms of the excellence of the plant.

Mr. F. A. Wunder has undertaken the management of the New York office of the Fort Wayne Electric Corporation at 120 Broadway. He has been with this company for the past five years as their Chicago and St. Louis manager. He was called upon suddenly to take this post of honor last May. Mr. Wunder made himself popular at the St. Louis meeting of the National Electric Light Association three years ago, when the great reception given by the Fort Wayne Co. was given.

To look over patent records would mean mental anguish to some people; they would see so many things so much better than their own. It is therefore better to look around for some new field not necessarily a year old, but at least untouched, and then consider the simplest and cheapest method of attaining your object. The rule, "try again," is never forgotten if you once *try to invent.*

Magnetism and Light.—Ingenuity will not be wanting to complete in time all the necessary electro-magnetic analogues, and to build up an inpregnable body of proof that will indicate that electro-magnetic radiation and what we commonly call light are one in essential nature, though differing in degree.

Side Flash.—The inductive opposition to electric discharge presented by even a short length of conductor, when the difference of potential between the ends is made very suddenly, is seen in the tendency under such circumstances to *side flash.* If a conductor, say a straight rod of copper, have one end to earth, and somewhere very near its side is the end of another conductor also "to earth," then if the free end of the first conductor is suddenly exalted in potential the impulsive rush of electricity meeting with such an obstacle in the inductance of the conductor spits or flashes out laterally and sparks to the other conductor. No conductor is able to prevent side flash altogether unless it has practically no inductance.

The Moon's Atmosphere.—The roughness of a large portion of the lunar surface is much greater than that of our most mountainous regions. The ridges everywhere show an abruptness of declivity and a sharpness of outline which seem to preclude all idea of the existence of those atmospheric agencies which are ever at work, smoothing down and rounding off irregularities on the surface of the earth.

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CONTENTS.

INSULATION AND TEMPERATURE.

The insulating properties of a body are not fixed. There no reason to suppose their permanency one of the most ticeable characteristics; in fact, the opposite is most quently the case. In looking over a list of materials, we e some that become entirely changed in their electrical operties when exposed to the differences of temperature at might be ordinarily applied to them for the substantia- n of this fact, or to see the effects of moderate heat or ld upon them.

One of the most familiar cases in our own experience is ass—which is practically an insulator in the generally cepted meaning of the word, but which becomes a better nductor to a very noticeable degree when heated. To fset this circumstance we may take a metal of almost y kind and see its gradual increase of resistance with ch additional degree of temperature. Materials are so markably different in molecular construction that it ould be almost expected that such differences exist and, is herein noted, to a striking degree. It requires but a ght change at times in the molecular constitution of a dy to so affect it that either its conductivity climbs up a high point or falls to a condition bordering on absolute n-conductivity. The relation these conditions bear to e another can be well appreciated in the case of bodies lding silicate and those of a purely metallic or semi- etallic nature.

The effect, therefore, of heat upon insulation or even of cold, becomes an interesting subject from other than an ordinary standpoint. It may illuminate our minds regarding the change in detail and possibly place in our possession a sufficiently large number of facts to formulate a theory explaining the inherent nature of this mysterious change.

It is not unlikely that the absence or existence of conductivity is due to the ether bed around the molecule more than the molecule itself. It is very likely that the molecule has a native property which enables it to fasten the minute atmosphere rigidly around it and resist other than the so-called "displacement current" which sweeps across even glass for an instant of time. A better knowledge of this condition would throw great light upon the phenomenon of conduction or its complete absence.

COMMERCIAL ENGINEERING.

The difference that exists between the engineering carried on by those attempting a commercial feat on an unsound scientific basis and those possessing a device having no doubtful elements in its construction, which they are about to place upon the platform of criticism, might be called, as we have headed this abbreviated sketch, the difference between commercial and non-commercial engineering. It is in certain respects dangerous to fail in the development of a commercial enterprise of a scientific nature. It has certain reactive features at that period of disaster which successfully spoils all future enterprises of a similar kind until at least the last mistake has been forgotten. Inventions not properly developed and placed before the public are likely to be completely ignored and contemptuously referred to. A few months or possibly years of patient experiment could have brought it to a state of full-blown maturity and immediately created a market for it.

The embryonic idea must be carefully nursed; its qualifications constantly reviewed and its crystallization assisted with all the aid a well-stored and competent mind can give it. Commercial engineering can only be carried out successfully on these grounds.

The failures are in excess of the successes because of unworthy haste; because the inventor is fascinated by the gleam of promised gold and therefore does not hesitate in bringing to a head an incomplete idea regardless of the interests of those, depending upon himself, that have practically placed themselves in his hands.

The Atlantic cable was almost abandoned as an unworthy enterprise after its first failure. It would not have required a second experiment had the conditions governing the first been carefully examined. The idea if valuable is worthy of completion, and although it is not unlikely imperfections will develop, they should not be so great as to mean a complete rehearsal of the old experiments and possibly the discovery that success is in certain respects impossible.

It is very noticeable, with but few exceptions, that when a man knows too much he ceases to be useful. The usefulness that is referred to is not that which means a *resumé* of the charitable, ethical or eminently social qualities which lend lustre to a man's career, but his ability to add to the good things of the world; in other words, as in the sense outlined to become useful. The raw, untutored mind is frequently more alive to suggestions of a certain practical order than the richly endowed and well cultivated intellect. The knowledge of many things is often an impediment to the new. The chances of getting off the track, becoming too complex, and losing sight of the simplicity required is very often seen in the inventions of scientific men. They are an excellent aid in perfecting an invention, but a poor hand indeed in providing the first thought. The necessity of inventing something gradually persuades many into the attempt. They are in the large majority, and for one that succeeds thousands fail.

EFFECT OF TEMPERATURE ON INSULATING MATERIALS.

A paper presented at the General Meeting of the American Institute of Electrical Engineers, New York, May 20th, 1896.

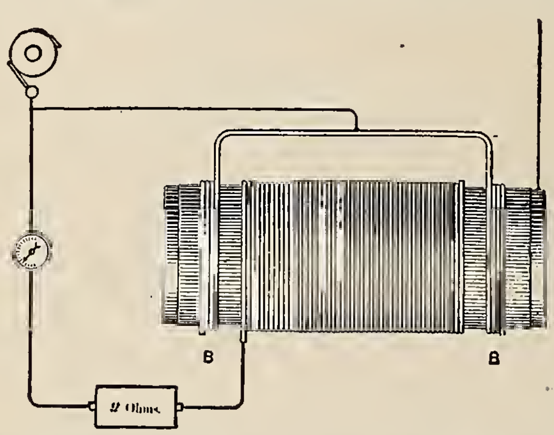
BY GEO. F. SEVER, A. MONELL AND C. L. PERRY.

In designing electrical apparatus, it is often of the greatest importance to know the effect of different temperatures on the insulation to be used in its construction.

Of the many kinds of insulation, a few of the most common were chosen, *i. e.*, paper, cloth, oiled paper and oiled cloth, and the following conclusions have been drawn from the result of 102 tests on samples of materials which were kindly furnished by several of the most prominent manufacturers of electrical machinery.

THE APPARATUS.

The heating apparatus consisted of a glass cylinder eight inches in diameter and ten inches high, covered at the top and bottom with asbestos plates. The lower part of this cylinder was occupied by 12 enamel resistance tubes, five inches long and 24 ohms each. The terminals of these were brought out through the asbestos plate. The current in these tubes being controlled by a rheostat, the tempera-



ture in the cylinder could be varied at pleasure. An inch above the heating tubes, and supported by an asbestos collar, was a metal plate having holes punched in it to allow the free circulation of air in the cylinder. This plate was connected to one side of a galvanometer.

The insulating material to be tested was wrapped on brass cylinders 3/4" in diameter and three inches long, the insulation not reaching quite to the end of the tube. The insulation was then wound with No. 26 B & S bare copper wire for a space of 2 1/2". Five tubes so wound were then placed on the metal plate in the cylinder and their terminals brought up through the asbestos cover, and then to a switchboard, in order that any tube might be thrown into the galvanometer circuit. This arrangement made it possible to heat five specimens at one time.

With the above apparatus was used a Thomson high resistance galvanometer, a megohm box and a difference of potential of 500 volts.

The thermometer used was of the nitrogen-filled mercurial type and capable of measuring from 0° to 400° C.

When troubled with surface leakage, it was eliminated in the following simple manner. The diagram shows the connections while testing a tube and also the leakage shunt.

It will be seen from the diagram, Fig. 1, that all of the current going through the galvanometer must pass from the dynamo to the brass cylinder, and thence through the insulation to coil A and on through the galvanometer. Any current tending to leak over the surface of the insulation from the brass cylinder to coil A will be intercepted and shunted past the galvanometer by coils B B.

During the investigation many different specimens of paper, oiled cloth, etc., varying greatly in thickness and composition, were tested, and it was found that each class has its characteristic properties strongly marked. We will now proceed to the discussion of each particular class.

PLAIN PAPER.

In this class 40 specimens were tested After the resistance at the temperature of the air (22° C.) was carefully noted, the temperature was gradually increased (100° in one-half hour) and readings taken every 10° up to 80° and from there on every 20°. Fig. 2 shows a curve which is characteristic of practically all kinds of plain paper.

It should be noticed, however, that in general the resistance of papers, that are not protected from moisture, falls between 22° and 50° and then rises rapidly until at 75° it has attained a maximum resistance. It should also be noted that this temperature of 75° is very constant for

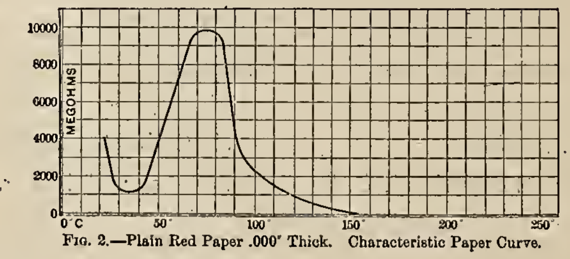


Fig. 2.—Plain Red Paper .000" Thick. Characteristic Paper Curve.

all kinds of paper. From 75° upward the resistance falls rapidly and at 150° is but a small fraction of its initial resistance.

The initial resistance of paper protected from moisture by japan (Fig. 3) is very high, but falls rapidly with the increase of temperature, as is the case with all material protected from moisture. (See oiled paper and oiled cloth). Hence we see that all paper having a porous structure and therefore containing more moisture, has a lower initial resistance than the protected paper, but is affected by heat much less than the latter. This would lead to the conclusion that there are two phenomena taking place. First the driving off of the moisture, which tends to increase the resistance, and secondly, some change (not a mechanical deterioration) in the material, dependent on the temperature, and which may be called the temperature coefficient. This temperature coefficient tends to lower the resistance with increase of temperature.

(*To be Continued*).

In New York there has been much litigation in regard to the elevated railroads. It has, however, been finally settled that, though the fee to the street is not vested in the abutting owner, and though his title to the adjoining premises may have been acquired from the city, or the streets have been opened under condemnation proceedings and he has been or is liable to be assessed for benefits thereby accruing to his property, or even where he owns lands abutting upon a street opened before the state government was established, still he has easements in such streets. These easements entitle him to a free passage of light to his abutting premises; an unpolluted supply of air, and to an unobstructed ingress and egress. These easements constitute property for an injury to which, as by the erection and maintenance of an elevated road, the owner is entitled to compensation.

The laying beneath the surface in streets of necessary pipes, cables, wires or conduits for sewers and drains, or the distribution of water, gas, electricity or steam, have all been held to be within the natural use for which the property was originally acquired, and do not impose additional burdens thereon or constitute the taking of property. This principle applies to urban and rural communities, where the improvements are made for the benefit of the inhabitants of that community; but where they are laid in rural highways, for the benefit of distant settlements, it has been held a taking under the law of eminent domain.

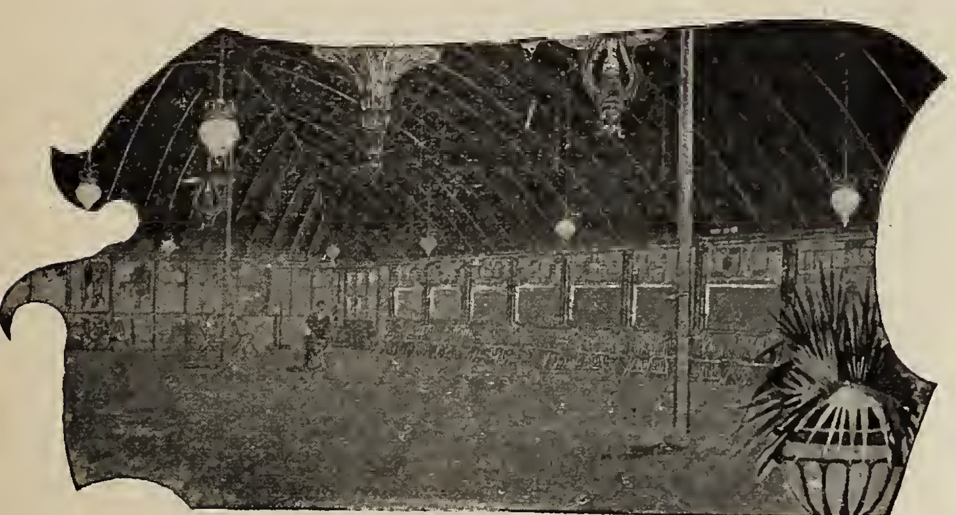
Dr. William Crookes. — The wonderful results obtained by Dr. Crookes in the production of very perfect vacua were of essential importance to the development of the incandescent electric lamp. Several of the instruments produced by Dr. Crookes in the course of his researches were in fact incandescent lamps, consisting of coils of platinum wire enclosed in glass vessels exhausted to a very high degree, the coils being heated to brilliant luminosity by electric currents.

TELEGRAPH SUPERINTENDENTS AT OLD POINT COMFORT.

People are apt to think that electricians and others of scientific attainments turn away from the comforts of the world with pitying glances.

They are supposed by many to rise superior to the trivialities of the day, and to enjoy the lofty discourse of their fellow professionals beyond all else. In many respects this is true, because without conceit they feel no restraint in each others presence and can parry and thrust with the keen edge of argument, feeling all the while the delight and satisfaction of expert swordsmen. There is in reunions of electrical men quite a little of this subtle joy and complacency at meeting rivals worthy of the steel. Aside from this slight introduction, the main object of the Society of Telegraph Superintendents in gathering at any given point is to combine business with pleasure. Old Point Comfort is not a bad place to choose for the firing of scientific volleys. Fortress Monroe is a monument to the battle and warring human elements that did not seek those victories which the bloodless battles of our friends provided; but with shot and shell tried to plough the soil and home into shreds. Facts may be demonstrated quite clearly in this manner, but it is much more satisfactory to visit the place without a repeating rifle, Hotchkiss gun or bared sabre. The meeting of the superintendents was held in the Hygeia Hotel. We believe as well as the management that it is "the unrivalled health and pleasure resort of the Atlantic coast." If there were big guns in Fortress Munroe there were "bigger guns" outside of it; we mean, of course, inside the Hygeia Hotel. Some little glimpses of the interior are also given to show the luxury and spaciousness of the meeting-place. It is quite appropriate to head this article with a shell, because without a doubt during the civil war a shell was the most familiar object that met their sight, and evidently they have not forgotten it; the proprietor of the hotel, therefore, sticks to his shell. We received an interesting little note in relation to the meeting of the society, an extract from which reads— "We had a very interesting session, and some valuable papers were read and important points brought out in the discussion of them."

HYGEIA HOTEL.



The Society of Telegraph Superintendents has done a great deal of good work in reviewing many matters in connection with telegraphy and other branches of electricity. Their good work in the past is shown by the way in which the meetings are attended. The fair sex are there presumably to assist their husbands and fathers unravel the more difficult points of discussion.

We think they often succeed very well—although at times it would seem that their appreciation of technical difficulties occasionally languishes.

We have added a list of the names attending the meeting, and certain other little matters of interest to our readers in connection with the meeting.

Niagara Falls will be the rendezvous, next meeting, and will probably afford as much pleasure to our friends of the society as Old Point Comfort.

THE HYGEIA HOTEL, OLD POINT COMFORT, VA.

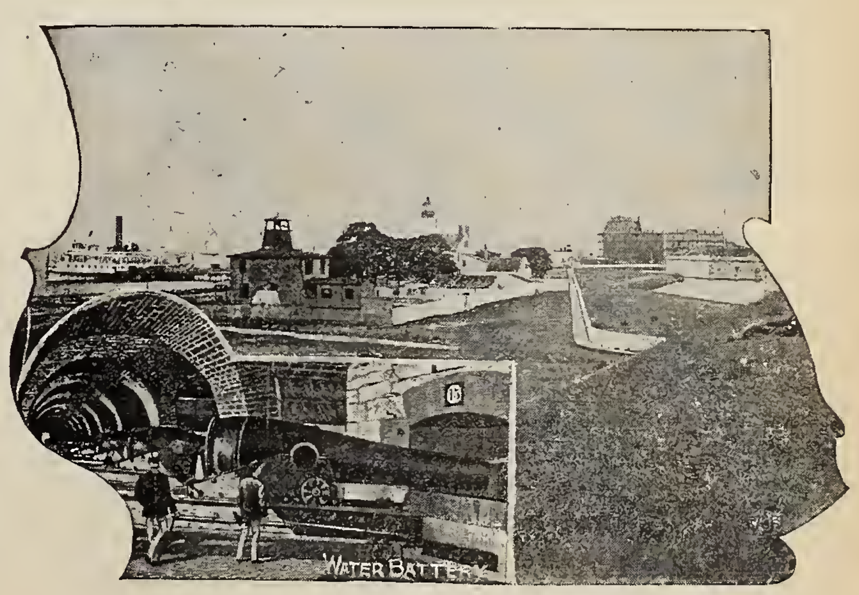
ASSOCIATION RAILWAY TELEGRAPH SUPERINTENDENTS.

Members present June 17 and 18, 1896.

M. B. Leonard and wife, Richmond, Va.; Chesapeake and Ohio Railway Co.

P. W. Drew and wife, Milwaukee, Wis.; Wisconsin Central Railway.

C. A. Darlton, wife and two daughters, Washington, D. C.; Southern Railway Co.



C. Selden, wife and daughter, Baltimore, Md.; Baltimore and Ohio Railroad.

G. M. Dugan, wife, son and daughter, Chicago, Ill.; Illinois Central.

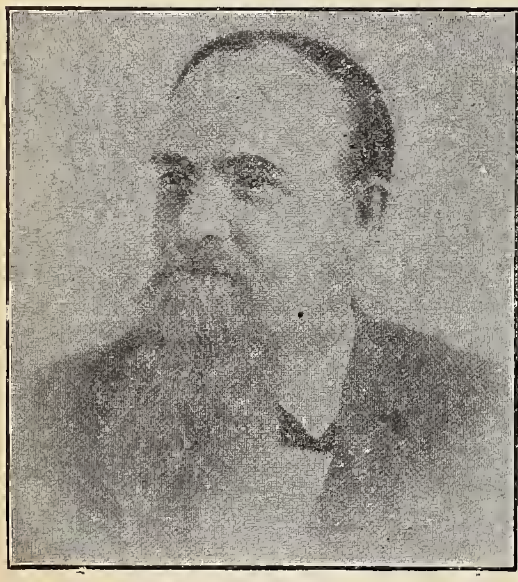
H. C. Hope and daughter, St. Paul, Minn.; C., St. P., M. & O. Ry.

A. R. Swift and wife, Chicago, Ill.; Chic., R. I. and Pac. Ry.

M. Magiff, wife and daughter, St. Albans, Vt.; Central Vermont

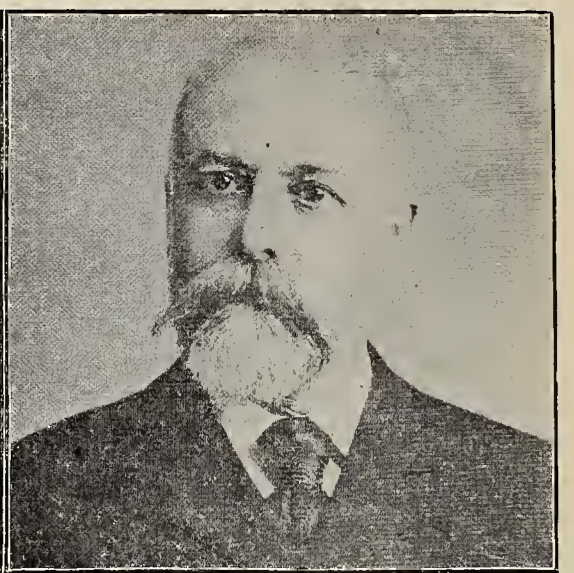
W. C. Walstrum, wife and daughter, Roanoke, Va.; Norfolk and Western Railway.

W. W. Ryder, Chicago, Ill.



GEO. M. DUGAN, PRESIDENT.
Superintendent, Illinois Central Railroad, Chicago, Ill.

J. W. LATTIG, VICE-PRESIDENT.
Superintendent of Telegraph and Signals, Lehigh Valley Railroad, South Bethlehem, Pa.



P. W. DREW, SEC. & TREAS.
Superintendent of the Wisconsin Central, Milwaukee, Wis.

W. H. Lovekin and wife, Toledo, O.

M. A. Baker and wife, Hannibal, Mo.; St. Louis, K. and N., and Chic., Burl'n and Kansas City.

I. T. Dyer and wife, St. Joseph, Mo.; Kansas City, St. Jo and C. Ry.

G. C. Kinsman and wife, Decatur, Ill.; Wabash Railroad.

H. C. Sprague and wife, Kansas City, Mo.; Kansas City, Ft. Scott and Memphis Railway.

U. J. Fry, Milwaukee, Wis.; Chic., Mil. and St. Paul.

Horace Johnson and wife, Cincinnati, O.; Baltimore and Ohio Southern Railway.

J. H. Long and wife, Lima, O.

N. McKinnon, Toledo, O.

G. L. Lang and wife, Boston, Mass.; N. E. R. R. Co.

W. S. Logue, Orange, N. J.

P. L. Clark and wife, Chicago.

H. M. Bartlett and wife, St. Joseph, Mo.

H. A. Tuttle, Minneapolis, Minn.

F. S. Spafard, Cedar Rapids, Ia.; B. C. R. N. Ry.

H. B. Ware, Wymore, Neb.

L. B. Foley and wife, New York; Del., Lack. and Western Railway.

E. A. Smith, Boston; Fitchburg Railway.

W. P. Ward, wife and two daughters, Cedar Rapids, Ia.

W. F. Williams, wife and daughter, Portsmouth, Va.

Geo. C. Maynard, Washington, D. C.

J. T. Ivey, Illinois Central, Vice President T. D. A.

J. N. Wilson, Zanesville and Ohio Railroad.

EXHIBITS.

Circuit Protecting Sounder Co.; by F. Ozanne, Memphis, Tenn.

Edison Phonoplex; by W. S. Logue, Orange, N. J.

The Best Telephone Mfg. Co., of Baltimore; by Lewis Ashman.

The Blickensderfer Mfg. Co., typewriting machines, Stamford, Conn.; by M. F. Adams, special agent.

OFFICERS ELECTED FOR THE ENSUING YEAR:

Geo. M. Dugan, president; Superintendent Telegraph, Illinois Central Railway, Chicago, Ill.

J. W. Lattig, vice-president; Superintendent Telegraph, Lehigh Valley Railway, South Bethlehem, Pa.

P. W. Drew, secretary and treasurer; Superintendent Telegraph, Wisconsin Central Railway, Milwaukee, Wis.

Next annual meeting to be held at Niagara Falls, June 16 and 17, 1897.

EXHIBIT AT FORTRESS MONROE.

W. S. Logue represented Mr. Thomas A. Edison at Fortress Monroe, and also represented and exhibited the circuit protecting sounder for the Circuit Protecting Sounder Co., of Memphis, Tenn.

The circuit protecting sounder is a new device, and is just being introduced.

An aluminium lever Bunnell sounder has attached to it a device by which any office in which the protecting sounder is placed can be called, and a bell started ringing; the bell will continue to ring until the telegraph operator comes in and stops it. There is also a device attached that will automatically cut-out an office where the key has been left open; at the same time start a bell ringing notifying the operator that his services are needed at the office. This is intended to save "wire" time, by not letting the operator keep his key open longer than desired; it being a time instrument, the time the instrument shall perform its work being decided by the officials of the road. A "ground wire" on the wire at any point where the "sounder" is placed can be removed by the "head office;" the time necessary to do this corresponds with the time that the instrument is set for.

I have no cuts of this instrument, but will mail you to-night, when I get to New York, a picture of the same.

Yours truly,

W. S. Logue.

CANADIAN LETTER.

ELECTRIC RAILWAYS.

St. Alphonse, Que.—The Chicoutimi Electric Co. will construct an electric railway between that place and St. Alphonse.

Hamilton, Grimsby and Beamsville.—The Hamilton, Grimsby, and Beamsville Railway has decided not to extend its lines to Grimsby Park and Beamsville this year.

Sherbrooke, Que.—The board of directors of the Sherbrooke, Que,, Street Railway Company are: J. W. Burke, president; F. J. Griffith, secretary; Walker Blue, Wm. Morris and J. E. Flood.

Dundas, Ont.—It is said that the Hamilton and Dundas Railway will be changed to electric traction at once. The line will be changed so as to be drawn into Dundas over it.

Hamilton Radial Electric Co.—The Hamilton Radial Electric Co. have awarded the contract for the electrical generating apparatus required for the operation of their road to the Canadian General Electric Co. (Ltd.)

Electric railway schemes are a good crop this year. Dr. Oille, of St. Catharines, has one in hand, and Engineer Powell, formerly with the International Radial Railway Company, has plans out to cover the same ground as the Intercolonial.

THE GAMEWELL FIRE ALARM AND POLICE TELEGRAPH CO.

The signal service of all cities has been greatly benefited by the apparatus introduced by the Gamewell Fire Alarm and Police Telegraph Co.

The necessity for automatic devices has dawned upon even the most sluggish mind. There are occasions when instantaneous communication is absolutely necessary. In cases of fire, delays are dangerous, and the best system installed would be one so perfected that it would automatically signal (when the fire starts) to the fire stations. Also the police box, whose apparatus is ever wakeful to send a signal when the call for help is heard. The burglar might just as well throw down his tools and beg for mercy if the Gamewell Co. have equipped the house. The business of house-breakers and fire bugs is slowly diminishing. The traps laid around an ordinary home or business house are enough to shatter the nerves of the most disreputable rascal that ever lived. The business the Gamewell Fire Alarm and Police Telegraph Company are doing is constantly increasing. It has got to increase as long as people want protection—at least at home. The new array of causes which stand on no ceremony in starting blazes are almost ineradicable. Spontaneous combustion and cigarette ends, escaping gas and traditional electric sparks, appear in every new building.

As long as dynamite and money are in existence the temptation is very great to use one with which to get the other. And so between the attacks on bank presidents for untold thousands, burglars and house firers, innocent or otherwise, the Gamewell protective and signalling systems are needed. They are so much needed that the company is always busy.

The class of apparatus they manufacture is very fine. No mistakes are likely to occur if this system is installed. They sell cabinet equipments for central offices and whistling machines in place of gongs for fire engines. Many a Dr. Nordaus degenerate, just released from state apartments, has looked up at large buildings and sighed as he realized that he could'nt play *that Gamewell.*

The Gamewell people have installed outfits in over 700 cities and towns. Every success possible has shone upon them. Their equipments are perfect and those that try them soon find this out.

Their address is No. 19 Barclay street, New York City; their President's name, Mr. J. W. Stover.

THE GAMEWELL EXHIBIT AT THE ELECTRICAL EXPOSITION.

Moncton, N. B.—The Moncton, N. B. Street Railway and the city have completed arrangements for the construction of the road. The tracks are to be left clear, the roads repaired when injury arises from the company's tracks, and new electric light poles will be erected by the company. The power-house will be on the wharf, thus securing cheap coal.

Cornwall, Ont.—Construction work is going forward on the new electric railway at Cornwall, Ont., referred to in last issue. The road will be six and one-half miles long, and the tracks are being laid with "T" rails to accommodate the freight traffic that is to be carried on between the various mills and the Grand Trunk. The rails are to be sunk in the roadbed, and the company are to keep the road in repair for eighteen inches each side of the rails. The Rathbun Company, of Deseronto, will supply the cars. A large power-house is being built on Water street. The company have purchased the Gillespie Point property, east of the town, as a park, in which a pavilion, etc, will be erected. Where possible, the track will be laid at the side of the street, to permit the repair of the sewers without disturbing the railway.

Burlington, Ont.—The Hamilton Radial Railroad has been granted right of way by the council of that city on a 32-year franchise, and is preparing to begin construction. M. W. Hopkins has been appointed chief engineer of construction. The company will strive to have the line between the city and Burlington Beach completed by Dominion Day. The power-house will be located at Burlington, Ont. J. Alcide Chaussé.

(*Q.*)—Electric Fans at Home.

New York, June 19, 1806.

Dear Sirs:—I have a mother somewhat ill and would like to cool her room at night with an electric fan. What is the best battery to use? The motor I have takes six volts and about three amperes.

(*A.*)—Many batteries may be tried for this purpose, but we recommend either the Gordon-Burnham or Multivolt. They are both excellent cells for this purpose and will give satisfaction.

Cranford, N. J.—Dr. W. C. Allen, of Cranford, is to build an electro-medical sanitarium on Springfield avenue.

ROENTGEN RAYS.

Effects of Magnetism.—A person may stand up betweeen the poles of the strongest magnet, one which might hold up a ton of iron, without the slightest perceptible effect upon any of the bodily functions being produced.

Light Giving Life.—The greater the electrical pressure brought to bear upon a lamp, the higher the incandescence attained. The lifetime of a lamp endowed at the outset with average vitality thus depends entirely on its treatment, and can be made almost what we please, from a few moments to even many years, according to the degree of incandescence it is called upon to produce.

A Carbon Filament.—At a certain electrical pressure on the filament the right quantity of electricity flows through it to bring its temperature to the incandescent point of due candle-power. At this pressure the lamp will last probably two thousand five hundred working hours. If our best microscopes had a magnifying power perhaps ten thousand times greater than that they now reach, and it were possible to subject the glowing filament to their examination, we might expect to find the ultimate particles or molecules of carbon vibrating and colliding with an intensity that now baffles the imagination. We can fancy that at the surface of the filament an occasional molecule projected outward with more than usual force would bound beyond the reach of retractive influence, and be hurled past recall against the inner, distant surface of the globe. Gradually the latter would be darkened by the thickening meteoric accumulation, while the filament would weaken as its dwindling substance (enduring such tremendous internal commotion) suffered structural decay, until at some point disruption would ensue, followed immediately by loss of conduction and extinction of the light.

GAMEWELL CO. POLICE SIGNAL CABINET OUTFIT.

Lewiston, Ont.—The New York Legislature has passed the bill providing for a new trolley bridge over the Niagara River at Lewiston.

THE HOLOPHANE.

C. ROTT, ESQ.
Secretary and Treasurer.

The first edict, "Let there be Light," has been re-echoed since the beginning of human history. There is in the minds of men an opinion that with light we have illumination, but they are wrong. Illumination is an art. The painter seeks it in displaying his finished canvas, and in the realms of nature herself an attempt as well defined and striking is seen in the distribution of light from the sun at meridian, at dawn and at night. The more light is reflected, the more diffused it becomes, and the more grateful to the sensitive eye as its uniformity and softness is felt by the appreciative retina.

Light is not what we need as much as its careful distribution. The thrusting of rays into the face creates a blinding, painful impression; but an even tone of light, faint or strong, is never forgotten by the pleased witness. The object of the Holophane is thus without further delay understood. A flint-glass globe, corrugated both inside and out, provides a means of diffusing the painful rays of light and breaking them up into myriads of little waves. Messrs. Blondell and Psaroudaki are to be congratulated upon the success they have gained; and the Geo. A. Macbeth Co. for having secured so valuable an article for the distribution of light.

The Holophane is taking a hold upon the public that few can conceive of. It is a beautiful shade for any light and may be suited to all the requirements of house or office, parlor or show-room. There is no globe that has so enlisted the attention and interest of the trade as the Holophane, and we, in common with the rest, echo the sentiments we feel. The Geo. A. Macbeth Co. have offices in Pittsburgh, Pa., where orders are promptly attended to.

HOLOPHANES.

Interesting Facts in Science.

Harder than the Diamond.—According to a note in *Nature*, Mr. Moissan is reported to have discovered a substance harder than the diamond, in the form of a compound of carbon and boron, produced by heating boracic acid and carbon in an electric furnace at a temperature of 5,000 degrees. This compound is black, and not unlike graphite in appearance, and it appears likely to supersede diamonds for boring rocks, cutting glass and other industrial purposes. It will even cut diamonds without difficulty and can be produced of any required size.—*Electrical Review*, London.

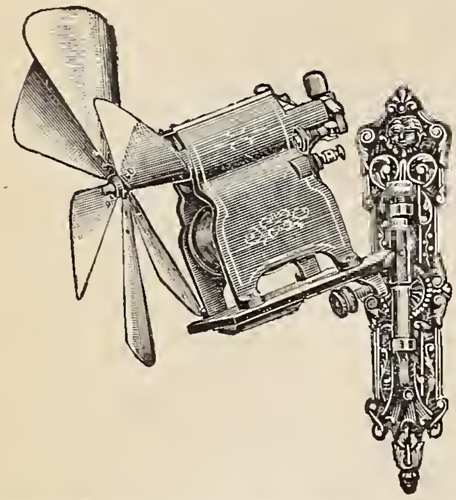
Collided for Science.—The 20,000 people who gathered at Buckeye Park on the Columbus, Hocking Valley and Toledo Railroad May 30, have a pretty well defined idea of a railroad collision. Two forty-ton locomotives, to each of which were attached three coal cars and a caboose, were run together at a speed of forty miles an hour. As one of the engines was a little faster than the other, preliminary trials of speed were made so as to bring the collision at a certain point. The engine W. H. Fisher was started 3,600 feet south of the point of meeting and the A. L. Streeter 3,000 feet north. The engines were started on the main track, and ran together on a siding in the park. Both engines were started at the same minute, the engineers jumping after opening the throttles. The engines met within about 100 feet of the calculated point. The immense crowd was silent with awe as the engines steamed into sight, each running at the rate of forty miles an hour. As the engines came together they reared up in the air and the cars behind them were telescoped, but the cabooses were only partially wrecked. Both engines were a complete wreck. Kinetoscopic and kaleidoscopic views of the wreck were taken by experts.—*Railroad Telegrapher*.

Comets.—The famous comet of 1811 was one of the largest of which we have any record; the diameter of its head was about 600,000 miles, and its tail extended to a distance of more than 60,000,000 of miles, so that its entire volume was nearly or quite as great as that of the sun itself. The great comet of 1769 was 500,000 miles in diameter and its tail not less than 50,000,000 miles in length. As already stated, the great comet of 1843 had a tail whose length was 150,000,000 of miles.

Meteorites.—When a very small meteorite enters our atmosphere it becomes incandescent and is visible for a short time as it moves along its path, constituting what is called a shooting star. When the meteorite is larger and when it becomes involved in a denser portion of the atmosphere it presents the appearance of a brilliant planet; it is frequently followed by a *train* of greater or less extent and oftentimes it explodes with more or less violence; it is then called a fire ball. When the meteorite is still larger it frequently escapes destruction in the atmosphere and falls to the earth, either as a unit, or, after one or more explosions, in fragmentary portions; the masses that reach the earth are called aerolites.

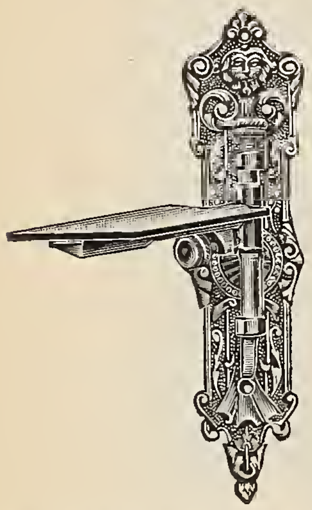
The Falling of Meteorites.—When the earth passes through a part of the stream where the meteorites are sparsely distributed the corresponding shower is inconspicuous; but when it passes through the denser regions of the stream the meteoric display is exceedingly brilliant.

THE NORTH AMERICAN ELECTRIC CO.



BRACKET AND TABLE WITH MOTOR ATTACHED.

For many years the old, conventional bracket has been in use with its wooden base and metal support. It was troublesome to put up and in certain respects unsafe. We can now leave this relic behind us. The North American Electric Co. have a metal bracket which contains several new features required for the ready adjustment of a fan motor. It is a handsome brass plate which supports a table at right angles to itself on which the motor is placed. A thumb-screw enables us to tilt the motor so as to carry the current of air to any point required. The plate supporting the motor is hinged to a vertical post which, in addition, allows lateral motion, thus allowing the current of air to be raised or lowered in position or turned by this device from side to side. It is far superior to anything on the market, and has and will find a steady run of customers. The plate screwed against the wall is somewhat elaborately finished, thus supplying an ornamental as well as a useful article. The tables for these brackets are made of different sizes to suit the various fan motors on the market.



BRACKET AND TABLE WITHOUT MOTOR

Their solidity and strength have been well tested, and in all cases more than met the requirements of practice. The North American Electric Co. sell a nicely finished set of fan motors of different sizes, both incandescent and battery, to suit the consumer's taste. They can be run with a few cells of battery, and have in all cases given the best of satisfaction. The North American Electric Co. are a bright and enterprising concern. They know what is wanted and stand ready to supply it all along. Their desk bracket proves this, as it is a novelty of the highest order in ingenuity and convenience.

Mr. John E. Fuller is the wizard that has unveiled all these valuable additions. You can call and see both him and the company at No. 181 William street, New York.

Johnstown, Pa., June 20, 1896.

One of the largest electric motors ever placed on a public platform for purposes of instruction was harnessed up and its workings explained by an expert at a public meeting held in this city on the evening of the 18th inst. The occasion was an Industrial Exhibition given by the Board of Trade, showing the new industries established in Johnstown during the present year. The motor was made by the Steele Motor Co., recently removed here from Cleveland, Ohio, and weighed over a ton. This company is now employing over 400 workmen.

N. F. Thompson, Secretary.

A copy of "Two to Fifteen Days' Pleasure Tours" will be sent free, postpaid, to any address in the world on receipt of two 2-cent stamps, by George H. Daniels, General Passenger Agent, Grand Central Station, New York.

Some of the most beautiful tours have been mapped out by the Central Railroad. They are so well known for the magnificent localities their lines pass through that it is unnecessary to review them. For summer vacations the Central road brings you to spots that are charming. The Thousand Isles, Niagara, St. Lawrence, Adirondacks and Lake George speak for themselves. The Grand Central trains reach every one. Make up your minds, if you have time, and travel comfortably.

Richmond, Ont.—An electric railway is proposed from Bell's Corners to Richmond, Ont., in the county of Carleton. This would be a branch of the Ottawa and Britannia line.

NEW TELEPHONE COMPANIES.

Kingston, N. Y.—Deep Notch Telephone Co., to operate a telephone line between Lexington, Hunter, Spruceton, West Hill, Bushnellville, in Greene County, and Shandaken, Ulster County; Capital $500; Directors, Frank M. Smith, of Brooklyn; Charles Tappen, Frank A. Palen, Everett Fowler, of Kingston, John D. Newton, 528 West 143d street, New York City, and Garrett Burgert of Ramapo.

Fort Dodge, Ia.—The Fort Dodge Telephone Co.; Capital, $10,000; Incorporators, E. H. Martin, C. F. Duncombe and C. W. King.

New Albany, Ind.—The Home Telephone Co. Capital, $20,000. To operate in Floyd, Clark, Jefferson, Washington, Orange, Harrison and Crawford Counties.

New Corporations.

Buffalo, N. Y.—The Cataract Power and Conduit Co. Capital, $2,000,000. To distribute electricity for light, heat and power in Buffalo. Directors: Daniel O'Day, Edward Adams, Francis L. Stetson, John Jacob Astor, 23 West 25th street, all of New York City, and others.

Carthage, Mo.—Jasper County Light and Power Co. Capital, $30,000. Incorporators: F. H. Fitch, William McMillan, J. A. Banks and others.

Logan, Ia.—The Logan Electric Light Co. Capital, $12,000. L. P. Bradley, president, and C. F. Luce, secretary.

Anniston, Ala.—The Anniston Electric Co., capital, $50,000, has been incorporated. Howard W. Sexton, president and treasurer; Dr. R. P. Huger, vice president; John B. Rees, secretary.

Berwick, Me.—South Peacock Mining Co. has been organized at Berwick, for the purpose of carrying on the business of mining in all its branches, to establish electric light and power plant for its own use, and also to sell and distribute electric light and power to other persons.

Telephone Notes.

Manchester, N. H.—An extension of the telephone underground conduit system is under contemplation. The plan includes an extension as far as Sagamore on North Elm street, and as far as Auburn street, south on Elm and east on Hanover to Maple street.

Washington, Pa.—The Waynesburg Telephone Co. will shortly erect a line between Washington and that place.

Marion, O.—The Central Telephone Co. will construct a new line between Columbus and Toledo. Marion, Findlay and Delaware will be the only places on the line which will break in on it.

Burton Village, O.—Dr. Warner was granted a franchise for establishment of telephone line from Burton Village to the centre of Newbury.

FREDERICKSBURG, VA.—The Fredericksburg Telephone Co. was organized. President, Henry G. Chesley; Secretary and Treasurer, W. S. White. The company expects to build a line to Orange at once.

POPLAR BLUFF, MO.—The Poplar Bluff Telephone Co. Capital, $10,000. Incorporators, R. Adams, F. Ray, and others.

New York Notes.

C. C. Sibley & Co. have their beautiful salesrooms on Fourth avenue, between 24th and 25th streets, New York. They are carefully equipped with all the latest apparatus required for light, heat and power.

The equipments required for hotel, office and general work are there for inspection. C. C. Sibley & Co. are well-known electrical engineers.

They have the whole building stocked with motors, dynamos and specialties ready to ship on immediate order.

The members of this firm are already famous for their extensive experience in manufacturing, installing and handling electrical apparatus of every description. They are selling agents for the Partrick & Carter Co., of Philadelphia, Pa., the noted manufacturers of specialties and supplies for office, hotel and general household use. The General Electric Co. have made them selling agents for their electric light supplies. The progressive power and energy of this firm is remarkable. Success has marked their efforts in every field they have undertaken. People on all sides express satisfaction and have every confidence in them.

W. T. Rutter, superintendent of the Interior Conduit Co. buried his wife Wednesday, June 10. The services took place at Lebanon, Pa. We are indeed sorry to hear of this misfortune and condole with him.

Harrington and Kittle met in Hartford, last week, and took the "glad hand."

Allen C. Bakewell, vice-president and general manager of the Interior Conduit and Insulation Co., is in Chicago, closing up some big deals.

The Standard Underground Cable Company's New York Manager, Mr. Geo. L. Wiley, Times Building, New York, secured the contracts for the Baltimore, Md., fire alarm, police telegraph and telephone service, amounting to 98,000 feet of cable for underground use. They also furnish 40,000 feet of weatherproof insulated and bare copper wire, cross-arms, pins and brackets.

Possible Contracts.

HUDSON, N. Y.—Sealed proposals will be received at the office of the Board of Managers of the House of Refuge for Women until one o'clock, June 25, for furnishing all the materials, building and installing an electric light plant in accordance with the plans, drawings and specifications. Each proposal must be enclosed in a sealed envelope, addressed to the Board of Managers and endorsed "Proposals for Electric Light Plant," and must be accompanied by a bond of $5,000, with two sureties, residents of the State of New York.

DOYLESTOWN, PA.—The latest trolley road to extend into Bucks County is the Bristol and Philadelphia Electric Railway Co., of which Col. Edward Morrell is president. The new railway is to be constructed on the Bristol turnpike, between Poquessing Creek, which forms the boundary of the city, and Bristol. The length of the road will be nine miles.

NORWICH, N. Y.—The Ontario and Western proposes to erect an electric light plant at Norwich, to light its buildings and yard at that place.

ATLANTIC HIGHLANDS, N. J.—Contractor Frank J. Davis will make necessary alterations and additions to the pumping station for the purposes of electric lighting.

The present contract for lighting the streets of Louisiana, Mo. (a city of about 6,000 people, one hundred miles north of St. Louis, on the Mississippi River), will expire about October 1, at which time or before the City Council will probably make arrangements for a plant operated under city control, make a contract with the present company, or accept bid from some other party.

Louisiana is peculiarly located for the erection of a plant very economically, owing to city not being scattered. The mayor of city is Henry L. Hart, to whom all inquiries should be mailed.

NEW YORK CITY.—Acme Electric Lamp Co. Capital, $50,000. Directors: L. A. Jackson, 23 Park Row, New York City; G. D. Phillips, of New Rochelle; Elbert C. Rosevelt, of Pelham Manor, and C. M. Cumming, of Yonkers.

CLARKSVILLE, TENN.—The Electric Street Railway Co., of Clarksville. N. L. Carney, R. H. Burney, R. F. Shelton, Julian Gracey, and H. P. Cholson, incorporators. The work of construction will begin as soon as possible.

ATHENS, GA.—A laboratory of electrical engineering will be established at the University of Georgia. The same will be in charge of Prof. A. H. Patterson.

CHATTANOOGA, TENN.—The Chattanooga Electric Street Railway Co. contemplates making improvements on its system to cost about $100,000. Address C. A. Lyerly, president.

BOSTON, MASS.—A syndicate of capitalists will soon build in the Back Bay a gigantic structure for all sorts of amusements. It will cost $2,000,000. It will be called the Colossic, and it will face the Fenway.

HIGHLAND, MD.—The Highland and Mill Green Telephone Co. Incorporated by A. G. Parker, F. N. Ramsey and others. Capital stock, $1,000. To construct a telephone system.

MACON, GA.—The City Council has been petitioned for authority by the Bell Telephone Co. for the construction of conduits and laying its wires underground. The cost is estimated at about $200,000. Mr. Weaver is manager.

WAYCROSS, GA.—The Waycross Telephone Co. contemplates extending its lines to Douglass, a distance of about twenty-five miles.

ELECTRICAL and STREET RAILWAY PATENTS.

Issued May 26, 1896.

560,652. Electromagnetic Motor. Frederick M. Schmidt, Brooklyn, N. Y. Filed Jan. 18, 1896.

560,658. Controller for Electric Cars. Elmer A. Sperry, Cleveland, Ohio, assignor to the General Electric Company, of New York. Filed Mar. 20, 1896.

560,667. Incandescent-Lamp Socket. Herbert C. Wirt, Schenectady, N. Y., assignor to the General Electric Company, of New York. Filed Feb. 17, 1896.

560,671. Electric-Arc Lamp. Thomas E. Adams, Cleveland, Ohio, assignor to the Adams-Bagnall Electric Company, same place. Filed Jan. 4, 1896.

560,675. Signaling Apparatus. John F. Barker, Springfield, Mass. Filed Feb. 16, 1895.

560,678. Electric Railway. Henry Brandenburg, Chicago, Ill. Filed Mar. 11, 1895.

560,679. Apparatus for Producing Musical Sounds by Electricity. George Breed, Philadelphia, Pa. Filed Nov. 20, 1894.

560,703. Electric Valve. Charles L. Fortier, Chicago, Ill., assignor to the Johnson Electric Service Company, same place. Filed Oct. 10, 1892.

560,721. Electric Railway. Edward H. Johnson, New York, and Robert Lundell, Brooklyn, N. Y., assignors to the Johnson-Lundell Electric Company, New York, N. Y. Filed Oct. 15, 1895.

560,735. Alternating-Current Generator. Walter S. Moody, Lynn, Mass., assignor to the General Electric Company, of New York. Filed Jan. 17, 1896.

560,737. Commutator-Brush. William H. Morgan, Alliance, Ohio. Filed Feb. 20, 1895.

560,751. Electric Brake. William B. Potter, Schenectady, N. Y., assignor to the General Electric Company, of New York. Filed Mar. 13, 1896.

560,763. Automatic Heat-Regulating Device. John V. Stout, Easton, Pa. Filed June 6, 1895.

560,766. Controllable Switch-Box. John Van Vleck, New York, N. Y. Filed Jan. 3, 1896.

560,772. Electrical Distributing System. Richard R. Bowker, Brooklyn, N. Y. Filed Feb. 27, 1896.

560,792. Electric-Arc Lamp. John H. J. Haines, New York, N. Y., and Alexander B. Fernald, Jersey City, N. J. Filed Jan. 7, 1896.

560,807. Conduit Electric Railway. Walter Lobach, Chicago, Ill., assignor of one-half to Francis B. Badt, same place. Filed Apr. 23, 1894.

560,819. Automatic Fuse. Harry C. Reagan, Jr., Philadelphia, Pa. Filed Sept. 6, 1895.

560,821. Electric Cut-Out. John C. Reynolds, New York, N. Y. Filed Jan. 25, 1896.

560,841. Current-Collector for Electric Railways. Albert N. Connett, Washington, D. C. Filed Jan. 17, 1896.

560,843. Car-Fender and Safety Attachment. Andrew O. Cunningham, New Orleans, La., assignor of two-thirds to W. Morgan Gurley and F. Rivers Richardson, same place. Filed Feb. 8, 1896.

560,849. Car-Fender. Manuel Fernandez, Los Angeles, Cal. Filed Oct. 25, 1895.

560,852. Static Electrical Machine. Charles M. Hollopeter, Fostoria, Ohio. Filed July 19, 1895.

560,894. Current-Collector for Electric Railways. Albert N. Connett, Washington, D. C., and Jacob S. Detrick, Baltimore, Md.; said Detrick assignor to said Connett. Filed Jan. 17, 1896.

560,902. Car-Fender. Frank J. Hopkins and George H. Miller, Newark, N. J. Filed Nov. 16, 1895.

560,903. Electric Railway. William H. Jordan, Brooklyn, N. Y. Filed Jan. 17, 1896.

560,917. Elevated Electric Railway. Jas. H. McGurty, Jersey City, N. J. Filed June 13, 1895.

560,921. Thermometric Circuit-Closer or Alarm. Richard Pearson, London, England. Filed Sept. 3, 1895.

560,931. Electrolytical Apparatus. William S. Rawson, London, England. Filed Mar. 21, 1895.

560,953. Car-Fender. Harold A. Webster, Haverhill, Mass., assignor to Herbert B. Newton, same place. Filed Sept. 14, 1895.

560,959. Car-Fender. Sylvanus D. Wright, New York, N. Y. Filed Apr. 11, 1895.

560,988. Electric-Railway System. Nicholas J. Halpine, U. S. Navy. Filed Feb. 1, 1893.

561,002. System of Electric Distribution, Pierre O. Keilholtz, Baltimore, Md., assignor of one-half to James F. Heyward, same place. Filed Feb. 29, 1896.

561,046. Electro-therapeutic Apparatus for Treating Deafness. Samuel J. Collier, Chicago, Ill.

561,061. Car-Fender. Frederick W. Nye, Cincinnati, Ohio, assignor of two-thirds to H. E. Young and Thos. P. Downes, same place. Filed Feb. 15, 1896.

561,073. Lightning Arrester. William Cooper, Schenectady, N. Y., assignor to the General Electric Company, of New York. Filed Sept 23, 1895.

TELEPHONE PATENTS.

ISSUED MAY 26, 1896.

560,757. Busy-Signal for Telephone Lines. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed Aug. 17, 1895.

560,761. Telephone-Circuit. John S. Stone, Boston, Mass., assignor to the American Bell Telephone Company, same place. Filed Mar. 13, 1896.

560,762. Telephone Circuit and Apparatus. John S. Stone, Boston, Mass., assignor to the American Bell Telephone Company, same place. Filed Apr. 2, 1896.

560,845. Telephone-Exchange System. Wm. W. Dean, St. Louis, Mo., assignor to the Bell Telephone Company of Missouri, same place. Filed Apr. 3, 1896.

560,861. Multiple Telephony. Frank A. Pickernell, Newark, N. J., and Frederic S. Perrin, New York, N. Y., assignors to the American Telephone and Telegraph Company, of New York. Filed Mar. 21, 1896.

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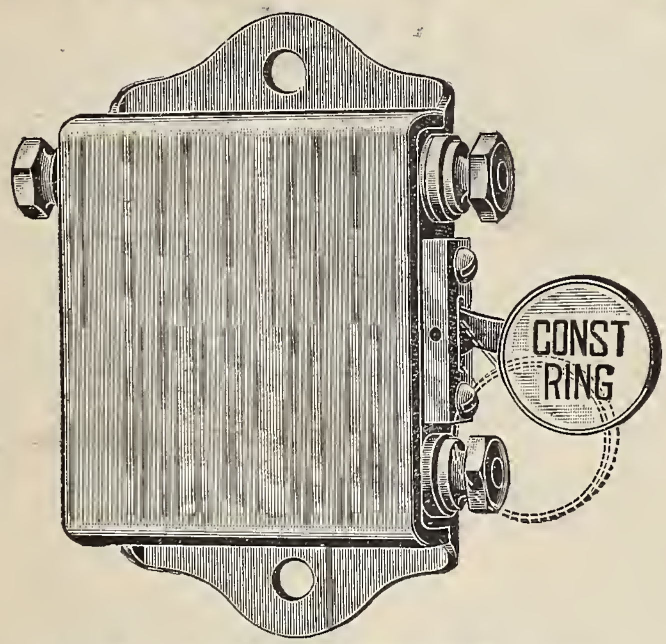

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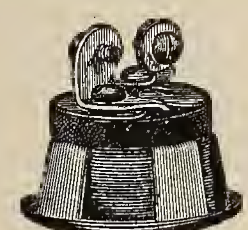

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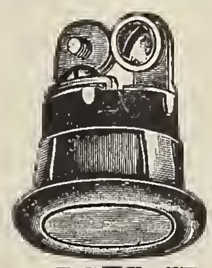

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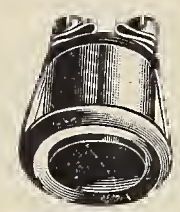

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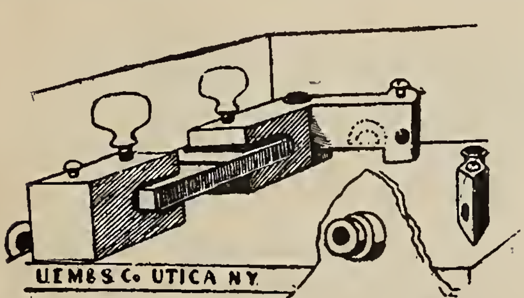

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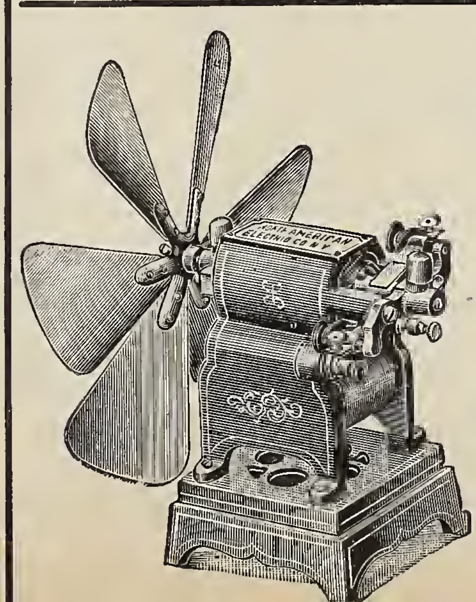

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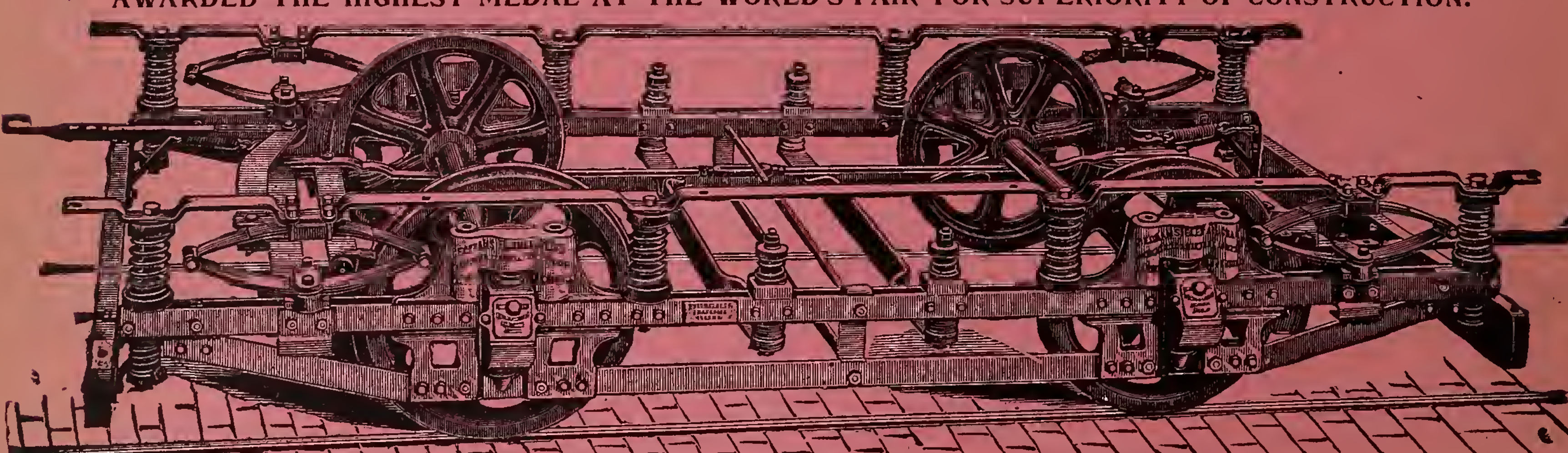

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